Problems in Army Vehicle Maintenance: Results of a Questionnaire Survey

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Rand

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PREFACE

This report presents and comments on the results of a questionnaire survey of U.S. Army land vehicle maintenance problems. The survey was prepared as part of the Rand Land Vehicle Maintenance Study sponsored by the Tactical Technology Office, Defense Advanced Research Projects Agency (ARPA). The primary purpose of the survey was to gain insights into the nature and relative importance of problem areas within the Army ground vehicle maintenance system. A secondary purpose was to elicit suggestions for plausible solutions to these problems, especially solutions involving technology. A subject of special interest was the present utility of and future requirements for test, measurement, and diagnostic equipment.

Caution should be exercised in interpreting the survey results. The survey addressed only problems in the maintenance system; no attempt was made to put these problems into financial, historical, or other perspective. The listing of such problems should thus not be seen as an evaluation of the total Army maintenance system.

SUMMARY

This report presents the results of a survey on U.S. Army land vehicle maintenance problems. Respondents consisted of civilian and uniformed Army maintenance specialists in continental U.S. and European commands.

Responses to the survey indicate deep and serious problems in the Army maintenance system that hamper efficient operations and degrade combat readiness. The following problems appeared to be the most serious.

RESULTS OF QUESTIONNAIRE SURVEY

1. Qualified Manpower Shortages

A shortage of qualified maintenance manpower exists in Army units because

a. Many of the authorized slots are unfilled.
b. A significant portion of the manpower that exists is unqualified to do the necessary work because the personnel are not properly trained.
c. There is relatively low utilization of maintenance personnel because of poor time management and the common practice of using such personnel in unrelated duties. The high turnover of personnel also results in productivity losses during arrival and departure periods of rotating personnel.

2. Training and Motivation

Training in schools and especially during on-the-job training (OJT) periods is another major problem. The average mechanic is poorly trained, especially in technical tasks such as troubleshooting. The level of school technical training has not kept up with increasing vehicle complexity. The burden of training has thus shifted to the unit, which is not equipped for the task. OJT is

generally not properly programmed; many respondents indicated that an OJT "program" with formal schedules, performance measures, and milestones simply did not exist.

Lack of motivation is an undercurrent of all the major problems. Poor motivation may be caused by the rapid turnover, the poor training, the perceived lack of respect and rewards for the working mechanic, and the absence of proper surpervisory or management control. The low level of motivation is evidenced by failure to follow prescribed preventive maintenance procedures, the careless handling of vehicles, the completion of maintenance forms with invalid data, and so on.

3. Periodic/Preventive Maintenance (PM)

Army regulations call for thorough inspection by the crew of a vehicle before, during, and after operation. Such inspection is generally not done. In addition, unit maintenance personnel do not properly perform those vehicle services required on a periodic basis (by time or mileage intervals). Thus, potential problems remain undetected and lead to major vehicle malfunctions, and the vehicle condition is degraded by the cumulative effects of contaminated lubrication, coolant, and carburetion systems.

4. Diagnosis and Diagnostic Equipment

The critical problem with diagnostic equipment is that it is normally not used. The major reasons appear to be poor diagnostic training and lack of enforcement of approved troubleshooting procedures. In general, there is an accepted mode of operation of "diagnosis by replacement"--troubleshooting by trial-and-error substitution of components.

5. Vehicle Operation and Crews

Operator misuse and abuse of vehicles are a major cause of damage and breakdown. Both intentional abuse (because the operator does not care about the vehicle's condition) and unintentional misuse (because he does not know any better) of vehicles occurs frequently.

Poor maintenance training and supervision contribute to the operator's failure to check the condition of his vehicle; this failure has an especially large effect because of the operator's important position at the base of the maintenance system. Reporting of faults is further degraded by a poor level of communication between operators and mechanics.

6. Vehicle Status Reporting

Much of the basic data on vehicle maintenance practices are sporadic and unreliable. Since the basic maintenance and equipment status reports tend to be unreliable, it is not surprising that the consolidated management records depict an inaccurate fleet maintenance history, and that unit status reports are often erroneous in their description of vehicle fleet readiness.

7. Management and Supervision

Most commanders do not have much interest in maintenance operations nor do they put enough emphasis on maintenance performance. Maintenance officers and NCOs are often untrained in their field, especially in terms of practical experience. Officers and NCO supervisors in typical units are seldom to be found in the motor pool, and the unit commander's Standing Operations Procedures are generally not disseminated to the mechanics in meaningful, understandable form.

A number of maintenance problems were described as of medium or secondary importance to the Army as a whole (although they could sometimes be critical for specific units or geographic locations). These included inadequate maintenance facilities, lack of proper equipment to conduct field repairs, special problems with vehicles coming from long-term storage, the availability of repair parts, and the availability of maintenance publications. Improvements in these areas are necessary and desirable, but it was felt that they would not result in a major upgrade of the maintenance system unless simultaneous improvements in the above major problems were made.

Some aspects of the maintenance system normally have only minor problems and were considered to be adequate most of the time: tools, fuel and lubricants, basic vehicle design, vehicle and parts production and rebuild quality control, maintenance record forms, and preventive maintenance schedules.

COMMENTS AND CONCLUSIONS

A major finding of this survey is the dominance of manpower-oriented problems. Management, training, and motivation head the list of problem areas. Other aspects of the maintenance system such as diagnostic equipment or data forms are generally not considered to be problems per se; the problems lie in the way personnel use such equipment, given the levels of management, training, and motivation. These manpower-related problems appear serious and deep-seated, and may be having a profound effect upon the readiness and combat capability of the mechanized forces.

A second major finding is a lack of reliable basic data in many facets of the maintenance system; how vehicles are operated, what makes them fail, how well periodic maintenance and repair services are conducted, and so on. Much available data are invalid, because they are poorly kept or falsified. Lack of reliable data may hamper commanders in conducting effective management, planners in formulating policy decisions, and designers in developing future vehicles that fit in with actual operations and support capabilities.

Technology could have an important role to play in improving Army vehicle maintenance *if* it addresses the manpower-oriented problems and *if* technology developers take a realistic account of the maintenance system and the capabilities and motivating factors of its personnel.

ACKNOWLEDGMENTS

My deepest appreciation goes to the Army personnel, uniformed and civilian, who put so much time and effort into filling out the survey questionnaires; it is my sincere wish that their comments and constructive criticisms will be made visible to an appropriate audience.

I am also indebted to the logistics personnel at the headquarters of FORSCOM, TRADOC, and USAREUR who reviewed and eventually distributed the questionnaires; to Lt. Col. T. Covington and Lt. Col. C. Buck of ARPA; and to W. J. Whelan and other colleagues at Rand for their support and helpful suggestions.

CONTENTS

PREFACE iii

SUMMARY v

ACKNOWLEDGMENTS ix

Section
I. INTRODUCTION 1
Background 1
The Army Maintenance System 1

II. METHOD 6
Survey Formulation 6
Questionnaire Format 7

III. RESULTS 9
Primary Problem Areas 9
Secondary Problem Areas 31
Minor Problem Areas 35

IV. SOME COMMENTS AND CONCLUSIONS 37

Appendix
A. GLOSSARY 39
B. THE QUESTIONNAIRE FORM 42
C. EVALUATIONS OF TECHNOLOGY CONCEPTS 112
D. MAINTENANCE DATA ESTIMATES 115

I. INTRODUCTION

BACKGROUND

This questionnaire survey is part of the Rand Land Vehicle Maintenance Study sponsored by the Defense Advanced Research Projects Agency (ARPA). The purpose of the study is to investigate means of reducing the peacetime costs and increasing the wartime effectiveness of the Army land vehicle fleet. To do this, study members have from the outset investigated the principal problems in Army maintenance, those problems contributing most to inefficiencies in the system as a whole. Extensive travel to Army bases and headquarters and interviews with maintenance personnel at all levels of responsibility have yielded many insights; however, it was impractical to personally contact personnel with "ground level" experience at Army bases worldwide. It was decided that a survey questionnaire was an appropriate instrument to effect the broad geographical coverage desired. A secondary desired benefit of such a survey was uniformity--each of the maintenance personnel contacted would be asked exactly the same questions.

After the following brief introduction to the organization of the Army maintenance system, Sec. II discusses the method used for the survey and the format of the questionnaire. Section III reports the results of the survey, and Sec. IV gives some of the conclusions the author reached from the questionnaire responses. A glossary appears in Appendix A. Appendix B provides the survey form, statistical data on results, and sample responses. Appendix C discusses respondent evaluations of seven technology concepts, and App. D summarizes respondent estimates of maintenance resources.

THE ARMY MAINTENANCE SYSTEM

Modern Army divisions are highly equipment intensive; the number of vehicles and vehicle types has grown rapidly in the last twenty years. Four general vehicle types, however, comprise the bulk of the Army tactical and combat vehicle fleet: tanks, armored personnel

carriers (APCs), 2-1/2 ton trucks, and the 1/4-ton trucks commonly known as Jeeps. Of the approximately 3700 vehicles in a typical armored division, some 2700 belong to these types. Only these four classes of vehicles were considered in the questionnaire.

Most modern Army vehicles are far more complicated than their World War II counterparts because of the addition of sophisticated communication equipment, fire control computers, night vision devices, laser rangefinders, and other items. The diversity of vehicles has also increased. The group of vehicles referred to here simply as "tanks," for instance, is actually composed of M48A5, M60A1, M60A1 RISE, M60A1 RISE Passive, M60A2, M60A3, and other vehicles, each of which requires unique skills and repair parts. Vehicle complexity and diversity contribute greatly to the challenge facing the modern Army fleet manager.

The basic Army philosophy is that maintenance is a command responsibility and should be performed at the lowest level practicable. There are four levels of maintenance: Organizational (Org, or "ORG"), Direct Support (DS), General Support (GS), and depot.

Organizational maintenance is performed by the crew (which may be a single operator) of the vehicle as well as by the mechanics organic to the unit that the particular vehicle belongs to. The crew is responsible for simple preventive maintenance (PM) services such as checking fluid levels, cleaning the vehicle, and lubrication. Certain services should be conducted by the crew each time it operates a vehicle; these are known as Before, During, and After operation (BDA) checks. Any significant problems discovered during these checks should be reported to company or battalion mechanics. The mechanics organic to the company and battalion perform simple repairs, which usually consist of inspecting components and replacing them if they are faulty. Only very limited repair of piece parts is allowed at this level. The battalion level stock of repair parts (which is available to Organizational level mechanics) is known as the Prescribed Load List, or PLL.

Direct Support maintenance performs more extensive repair on components and assemblies than is the case at the Organizational

level. Direct Support can be thought of as division-level maintenance (see Fig. 1), although this is somewhat oversimplified. Each division has a DS battalion. One company of this battalion remains at a central division-level facility. The three other companies of the DS battalion (known as Forward Support Companies) are assigned forward to support Organizational mechanics;[1] the usual practice is to assign one Forward Support Company to each brigade in the division. The stock of repair parts available to DS mechanics is known as the Authorized Stockage List, or ASL.[2]

General Support maintenance includes more extensive repair of subassemblies than DS, limited overhaul of major assemblies such as tank packs (engine-transmission assemblies), major body repairs, and technical support for items such as computer and electronics components. GS mechanics can be civilian as well as military.[3]

Depot-level maintenance was not addressed in the questionnaire survey. Depots overhaul entire vehicles and components and perform repairs beyond the capability of GS units. Depots are usually manned by civilians.

The Army document that delineates responsibility for "who fixes what" is known as a Maintenance Allocation Chart (MAC); each vehicle has its own specific MAC. A page from such a chart is presented as Fig. 2.

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[1]This "support" is intended to consist of performing DS-level work, rather than helping host unit mechanics with Organizational-level work.

[2]This is not to imply that Organizational mechanics may never use parts from ASL stocks. Rather, the ASL is a list of parts authorized for stockage by a DS unit.

[3]It is also possible for civilians to be Organizational or DS mechanics, but this is less often the case.

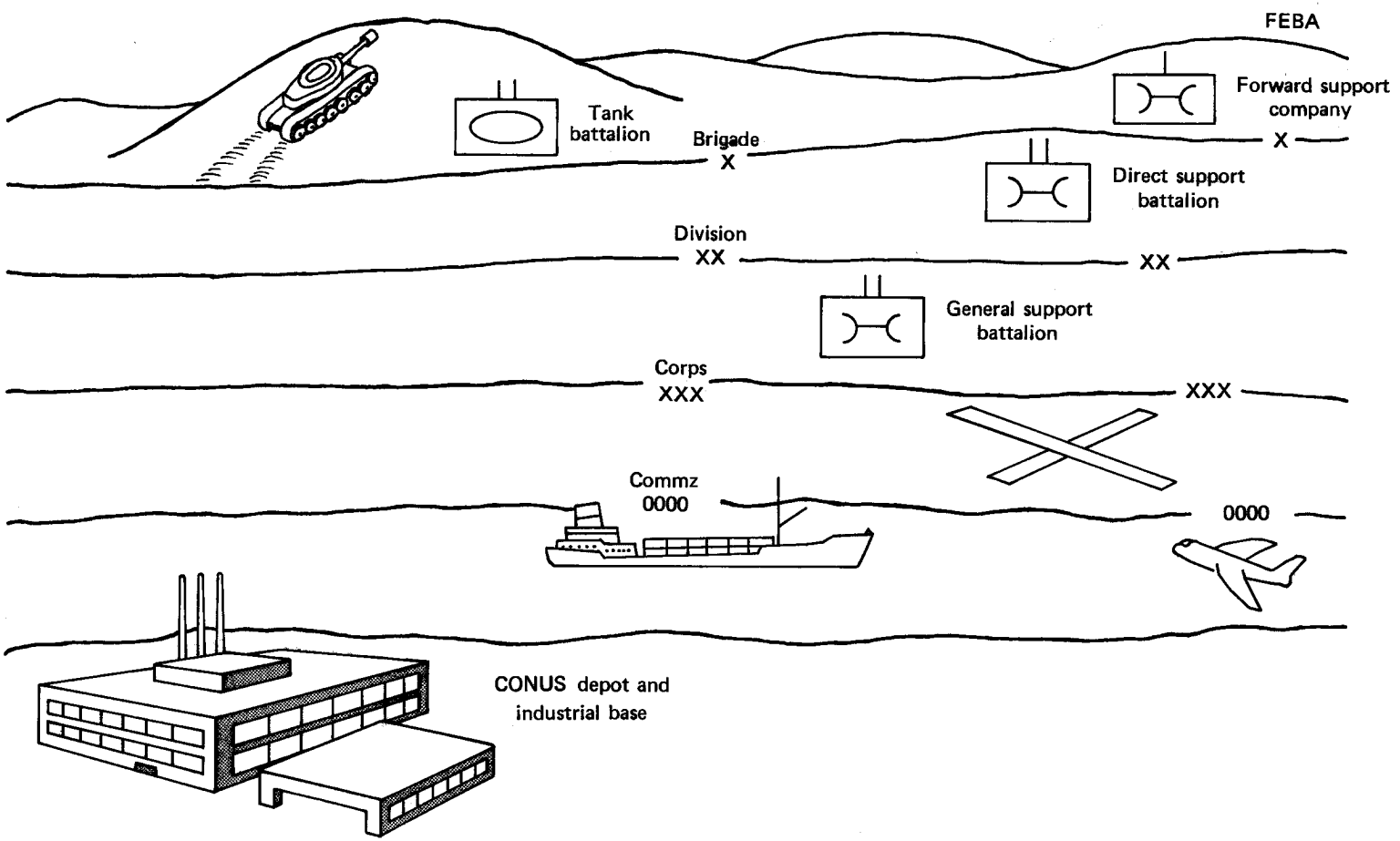

Fig. 1—Army maintenance system overview

(From *Defense Resource Management Study*, Government Printing Office, February 1979)

GROUP NUMBER	COMPONENT/ ASSEMBLY		MAINTE-NANCE FUNCTION	MAINTENANCE CATEGORY				REMARKS
				C	O	F	H	
3403 9 CONT	Indicator, Azimuth M37							
		1	Inspect	M 0.2				
		2	Test		M 0.2			
		3	Service	M 0.2				
		4	Replace		M 1.0			
		5	Repair			D 0.8		
		6	Overhaul				D 1.2	
10	Laser Rangefinder Knobs & Attach-ing Hardware							
		1	Inspect	M 0.2				
		2	Replace		M 0.5			
11	Transmitter Receiver							
		1	Inspect	M 0.1				
		2	Test	M 0.1				
		3	Service		M 0.1			
		4	Adjust			M 1.5		
		5	Align		M 2.0			
		6	Replace		M 1.5			
		7	Repair			M 2.6		
		8	Overhaul					Depot Lvl
12	Gunner's Controls							
		1	Inspect	M 0.1				
		2	Test	M 0.1				
		3	Replace		M 0.3			
		4	Repair			M 1.1		
		5	Overhaul					Depot Lvl
13	Display, Command Indicator							
		1	Inspect	M 0.1				
		2	Test	M 0.1				
		3	Replace		M 0.5			
		4	Repair			M 1.1		
		5	Overhaul					Depot Lvl

Fig. 2—Maintenance allocation chart (MAC)

(From Field Manual 42-9-8, *Maintenance and Repair Parts Consumption Planning Guide for Contingency Operations: Tank, Combat, Full Tracked,* Hq U.S. Army, November 30, 1978)

II. METHOD

SURVEY FORMULATION

As noted above, it was decided to limit the scope of the survey to four classes of ground vehicles: tanks, armored personnel carriers, M35 2-1/2 ton trucks, and M151 1/4-ton trucks. Only below-depot levels of maintenance (Organizational, DS, and GS) were addressed. Finally, the survey was intended to be a gathering of opinions about *problem areas* in the Army maintenance system; it was never intended to be an overall description or evaluation of that system, and should not be considered as such.

A relatively small population of senior Army maintenance specialists was chosen as potential respondents for the survey. The small size was required because each questionnaire took up to eight hours to complete; a large survey population would have resulted in too much fill-out and processing time. The particular group of specialists was selected because of (a) extensive background in practical or "ground-level" maintenance and (b) a high degree of similarity from base to base, i.e., the basic duties of respondents were essentially the same, no matter what base in the United States or Europe they were stationed at. (An otherwise attractive group of potential respondents, the logistics inspection teams (known variously as COMETs, METs, COMAINTs), was dropped from consideration because their organization and function varied too widely from base to base.)

The respondent group included the Maintenance Assistance and Instruction Team (MAIT) chiefs and their assistants, division and corps G4s, and directors of Directorates of Industrial Operations (DIOs) or their assistants. MAITs provide maintenance assistance to Organizational and DS/GS units in a large area (usually one team per major Army base) on a rotational basis. G4s are the logistics assistants to division or corps commanders. DIO directors are in charge of higher level maintenance (usually GS) for Army base support. A few specific additional personnel were included at the recommendation of the major commands.

The questions in the questionnaire were formulated on the basis of field visits as well as in-house and other studies. The draft questionnaires were pretested at several Army bases. The final questionnaire evolved after feedback from the pretests and from the maintenance directorates of the three commands in charge of the Army bases to be surveyed was incorporated into the draft.

The questionnaires were sent to all bases with division-sized forces in the United States and Europe. They were distributed by the major commands in charge of those bases: the Forces Command (FORSCOM) and the Training and Doctrine Command (TRADOC) in the United States, and the U.S. Army, Europe (USAREUR) overseas. Coordination with these commands and other Army headquarters was of high priority throughout the survey.

The completed questionnaires were returned directly to Rand for processing. Of 135 questionnaires sent out, 95 were returned, for a response rate of approximately 70 percent. Respondents appeared to be quite conscientious; many wrote essays of up to five pages on particular questions. The average military maintenance experience of the respondents was 20.6 years. The respondent group thus had a total of almost two millenia of background in this field.

QUESTIONNAIRE FORMAT

The questionnaire has a detailed, in-depth format. There are over 200 major questions, including statements requiring yes/no answers, evaluations on numeric scales, and open-ended essays. Completion time for a questionnaire form is from three to eight hours.

The questionnaire has five sections. After asking for the respondent's maintenance background (Sec. 1), the questionnaire addresses potential problems in various facets of the Army maintenance system (personnel, facilities, repair parts) in Sec. 2. Respondents were asked to evaluate the relative importance of each problem to the maintenance system as a whole. Additional open-ended questions asked for elucidation on each topic the respondent considered to be a problem. The next questionnaire section (Sec. 3) asked for possible solutions to each of the problem areas. The final sections asked for evaluations

of seven technology concepts that the Rand study team was considering (Sec. 4) and for estimates on time and repair parts utilization in the Army maintenance shops (Sec. 5).

The questionnaire form is included as App. B. It is filled in with a summary of respondents' answers, in italics. Numerical summations have been entered next to statistically amenable questions of the yes/no type. A sample of the most common responses to the open-ended questions is also included, to allow the reader to get a feel for the types of responses obtained.

III. RESULTS

This section presents the chief results from the returned questionnaires: identification and evaluation of problem areas in the maintenance system. Recommended solutions accompany each item. Some additional results can be found in App. C (Evaluation of Technology Concepts) and App. D (Estimates of Maintenance Data).

The problems stated below occur in Organizational and Direct Support maintenance levels, and only to a much lesser extent in General Support, especially civilian General Support. It is important to keep in mind that these problems do not apply to every Army unit, but rather refer to an "average" unit, or to units in the Army as a whole.

Recommended solutions follow each problem description; they are condensed from the solutions the respondents suggested in Sec. 3 of the questionnaire. Only solutions that received a signficant consensus are given. It was not assumed that respondents possessed analytic or other talents necessary to determine the economic or other feasibility of any solutions offered.

Problems identified by survey responses have been organized into general groups in this section; different groupings are obviously also possible. Problems are determined to be primary, secondary, or minor, according to the importance that respondents attached to them.

1. PRIMARY PROBLEM AREAS

The problems judged to be most serious can be grouped into seven general areas:

- o Qualified manpower shortages
- o Training motivation
- o Preventive maintenance
- o Diagnosis and TMDE
- o Vehicle operation: operators and crews
- o Vehicle status reporting
- o Management and supervision

Topics such as training and management relate to more than one area; there is an obvious overlap of subject matter between groups. Each of the seven areas is discussed below.

1.1 Qualified Manpower Shortages

A serious shortage of available qualified manpower to perform maintenance results in backlogs, the performance of "paper" maintenance rather than actual work,[1] and the migration of workloads to higher maintenance levels. Five factors contribute to the shortage of qualified manpower.

1. Lack of Personnel. Many units have fewer personnel than are authorized by their Table of Organization and Equipment (TO&E) (see App. B, p. 6). Some units, for instance, reported having only about two-thirds of the tracked vehicle mechanics they are authorized. There are critical shortages of tracked and wheeled vehicle mechanics, of motor sergeants in these two specialties, and of maintenance-related records clerks. The shortage of qualified mechanics and supervisors results in an obvious shortage of man hours available; the shortage of qualified clerks can result in personnel from other Military Occupational Specialties (MOS) (such as mechanics) being pulled into these jobs, as well as wrong parts being ordered, with concomitant increases in vehicle downtime.

2. Turnover. The turnover of personnel in units also results in lost man hours--the arrival and departure time overheads of maintenance personnel are lost work hours; orientation of new personnel upon arrival takes away some supervisor time as well (see App. B, p. 7).

This turnover is not just a result of normal personnel rotation from base to base. A very large part is between units at the same base, or within units, and much is due to the relatively inflexible rank structure. A mechanic or vehicle crewman is allowed only a certain rank in a particular slot, and must often move elsewhere when he is promoted.

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[1] "Paper" maintenance is work that supposedly has been done, but in fact exists only on official records.

Turnover is not the only problem associated with present promotion policy. The relatively narrow range of rank allotted to maintenance personnel as basic workers forces them quickly into other types of job upon promotion, generally into supervisory or administrative duties. Many personnel who are adequate mechanics are either unsuited for administrative work or are loath to perform it; however, since they have no choice under the present "up or out" promotion policy, they must either transfer to jobs that do not fully utilize their real skills or leave the Army.

3. MOS Misassignment. Personnel with certain maintenance-related MOS are often assigned to duties other than those they were trained for in the unit (see App. B, p. 10). Mechanics, for instance, may be used as drivers, clerks, or for duties for which no official TO&E positions are authorized in the unit.

4. Manpower Utilization. Utilization of maintenance personnel for maintenance-related tasks is low (see App. B, p. 10). For instance, the typical mechanic will spend only about 20 percent of his work day performing maintenance,[2] primarily because his day is constantly interrupted with tasks unrelated to his basic job. Even if he is not permanently assigned to a position other than mechanic, he will be assigned temporarily to guard duty, tool room clerk, or other task. Post events such as parades and physical training take up additional time. Finally, since supervision tends to be rather loose, much time may simply be unaccounted for. Poor management of this type is due not only to the lack of physical presence of supervisors and officers in the typical motor pool, but also to a general lack of training in maintenance and maintenance management for such leaders. Some leaders appear to be intimidated by maintenance, especially such technical tasks as troubleshooting.

5. Improper Training. Many units have a significant number of mechanics who were not school-trained in their specialty (see App. B.,

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[2]This figure correlates well with results of an Army Audit Agency study that reports a utilization rate of about 18 percent (*Report of Audit: Maintenance Support Active Army Forces in CONUS*, U.S. Army Audit Report S 76-233, 23 June 1976).

p. 8). Even school-trained mechanics cannot perform many jobs because they were poorly trained in the first place (see App. B, p. 8) or they forgot schooled skills during an intermediate assignment in a non-maintenance slot. Improperly trained personnel can also drain extra supervisor time during the on-the-job training (OJT) process.

In short, there is a strong consensus that most units lack much of the qualified manpower required to perform needed maintenance (and concomitantly, much maintenance work was not performed by units) because (1) personnel are not in the units in the first place, (2) personnel are in the units but are unavailable on a day-to-day basis, or (3) personnel are available but not qualified.

Some of the maintenance workload that is not performed is obscured by records that inaccurately describe the work as having been done; this is especially true of periodic maintenance (PM) procedures. A large part of the maintenance workload is retrograded upwards, to higher levels of maintenance, eventually winding up in the predominantly civilian (and production-oriented) GS and depot workshop. The lack of proper control over such migration means that units can effectively dispose of much of their workload this way.

1.1.1. Respondents' Recommendations. Some of the more critical TO&E shortages, especially for maintenance noncommissioned officers, should be reduced by the Department of the Army. (For a sample of respondent recommendations on this subject, see App. B, p. 43.)

Turnover could be reduced by a richer and more flexible rank structure, allowing personnel to remain in the same position even after one or two promotions.

Recommendations on alleviating MOS misassignment were mixed; some respondents feel that transfer of personnel carrying mechanic's MOS to lesser duties may be desirable to get rid of "bad apples."

Improved utilization of maintenance personnel is strongly urged. Low utilization of manpower in the motor pools is not inevitable--many units are able to get a much higher percentage of time spent on the job by rearranging unit work schedules to leave mechanics undisturbed, and by involved and emphatic supervision to control the amount of "personal time" spent during the work day. A command policy

mandating the physical presence of leaders in the maintenance areas is recommended, as are remedial or refresher training programs for leaders in maintenance and maintenance management.

Proper OJT programs and refresher training programs should be initiated to alleviate the inability of many mechanics (both school-trained and ad hoc) to perform necessary maintenance tasks.

1.1.2. Author's Comments. If the shortage of qualified maintenance personnel is as serious as respondents reported (or, put another way, if typical units are unqualified to handle anything close to a full maintenance workload), then either improvements or alternatives to the present system are badly needed if the maintenance effort is to properly support Army tactical vehicles in a future combat theater. The underutilization of personnel in maintenance slots may not in itself be a critical problem; it could be argued that in time of war the unrelated duties these personnel now perform would disappear and they would be "fully available." The same could be said for the migration of much of the workload to higher maintenance: in time of war, when civilians would probably not be available to work in a combat theater, those maintenance functions that official policy (and the Maintenance Allocation Charts) allocate to the lower maintenance echelons will be fully taken over by them. However, there are two problems with this line of argument: (1) the vehicle fleet may enter the war seriously degraded as a result of maintenance neglected in peacetime, and (2) it is unlikely that Organizational and DS mechanics can learn overnight those tasks that they should have been performing all along; they will lack not only the knowledge and experience to perform many such tasks, but even the spare parts necessary to carry them out, since both Organizational and DS spare parts inventories are based on demands experienced in previous time periods.

Objective, in-depth research on the capabilities of lower levels of maintenance to carry out duties assigned to them seems badly needed. More centralization of the scarce qualified manpower resources may be called for; this is one avenue now being explored by the Army's DIVISION 86 study program. Another possibility includes more modular replacement policies in wartime, up to and including

replacement rather than repair of entire vehicles; such policies would of course require significant and costly increases of War Reserve Materiel stocks.

Technology developments in the past have exacerbated rather than helped these problems, by making vehicles and components more complicated, bulky, and prone to failure, and by continually raising the thresholds at which maintenance personnel could be considered qualified to support the vehicle fleet. A strong positive emphasis (rather than just lip service) appears necessary in future Army R&D programs to ameliorate personnel-related maintenance problems. It would be particularly beneficial in achieving this objective to have the technology to monitor operations of typical units across the Army spectrum rather than just specially trained or "laboratory" personnel.

1.2 Training Motivation

The quality of school MOS training was found to be inadequate in three basic regards: (1) training in diagnosis and use of Test, Measurement, and Diagnostic Equipment (TMDE), especially for electric and automotive troubleshooting; (2) hands-on training and practical experience interacting with equipment; and (3) training in Technical Manuals (TMs) and other publications, especially as they are used in the motor pools (see App. B, pp. 8-9).

Most personnel do not receive proper school training in maintenance, and many never receive *any*; an average of approximately 30 percent of personnel working in maintenance-related tasks have received no formal training in their jobs (see App. B, p. 8). The estimated percentage of personnel not formally schooled in the maintenance jobs they perform varied widely from base to base, reaching a low of about 10 percent in some USAREUR units and a high of some 80 percent in Reserve units. There are no or only inadequate provisions for formally retraining such personnel by refresher courses or other means.

The Army on-the-job training (OJT) program is crucial to the education of maintenance personnel because (1) the training for most specific maintenance tasks that must be performed on a unit's

equipment is relegated to OJT, and (2) as many personnel receive no formal maintenance training at all, they are solely dependent on OJT for their skills. The severity and extent of flaws in OJT were judged to be far more serious than school shortcomings; *most units were described as having no discernible OJT program*--if by a program one means a planned, scheduled procedure with milestones and final achievement tests. Factors contributing to the inadequacy of the OJT process include a lack of qualified supervisors and senior personnel to conduct such a program (especially in a one-on-one master-apprentice sense), a lack of scheduled time for OJT (due to unrelated tasks and details performed by students), and a failure by management to assure that consistent training and achievement testing are actually carried out.[3]

In summary, training was assessed as being very poor at all levels--for crews, mechanics, supervisors, and motor officers. Further, some aspects of the situation are getting worse--OJT is deteriorating as equipment becomes more sophisticated and diverse (and thus requires more knowledge to operate and maintain), and the pool of supervisor skills is becoming more dilute as new NCOs emerge from inadequate OJT to pass on their insufficient knowledge and experience.

References to poor motivation permeated responses in almost all sections of the questionnaire. A major cause of poor motivation was described as lack of professional standing. The status of maintenance personnel, especially mechanics, is perceived as that of "grease monkeys" doing a job "almost anyone can do" rather than that of professional technicians. This lack of status affects both performance and time spent on the job. A second cause for attitude problems is frequent turnover--mechanics, drivers, and other personnel in the vehicle fleet tend to feel less reponsible for their jobs upon arrival ("Don't blame me--I just got here") or before imminent departure ("Can't get involved now--I'm leaving"). Since frequent turnover may make it

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[3]Army Reserve respondents noted that maintenance units in the Reserves did little actual work on the types of equipment they were to support in wartime. A policy of this sort would of course add to OJT shortcomings.

difficult for personnel to develop a sense of belonging to the unit, it can impair basic motivations.

1.2.1. Respondents' Recommendations. Improved training for vehicle operators and mechanics could be realized by more hands-on instruction with practical tests in school, and on the job by more systematic one-on-one assignment of the novice with an experienced NCO (see App. B, pp. 43-44). On-the-job training in general needs much more attention; units need consistent, formalized OJT courses with written plans and progress reports, not catch-as-catch-can training. As with on-the-job work productivity, OJT needs (1) more uninterrupted time each day it is to take place, and (2) the presence and involvement of NCOs in the motor pool. Some initial OJT could also be conducted at a centralized battalion or base level facility with experienced instructors, especially OJT for some of the rarer or more technical military occupational specialties.

A general solution offered for motivational problems is the establishment of a more "professional" maintenance force. Respondents believed that improved rank structure and pay for senior personnel (those reenlisting at least once) would result in greater professional pride, less turnover (because maintenance personnel could remain at their positions after being promoted, rather than being forced into slots elsewhere), better utilization and productivity, better retention (and thus fewer personnel shortages), and a higher return on the training investment. The emphasis on rank is not for more NCO slots per se, but for increasing the number of slots for NCOs performing maintenance rather than primarily administration. The establishment of a proper career path for a mechanic *as a mechanic* is a high priority need.

1.2.2. Author's Comments. There was strong agreement among respondents that the training program for maintenance personnel is inadequate, and that most vehicle operators, mechanics, and leaders are unable to perform many tasks required of them. This lack of proper training leads not only to low productivity, but also to morale problems. The weakest part of the Army training program appears to be the OJT process, which has been degraded from its original intent of

allowing for a flexible program suited to local needs to a catch-as-catch-can process that can no longer be called a "program" in any strict sense.

There is a great temptation for the Army--or any other large organization--to respond to a problem of this magnitude by investigating and initiating a long list of specific improvements, providing a general feeling of reassurance that the problem is being handled and will eventually be solved. Many respondents characterized such quick fixes as Band-Aids on a growing wound, and suggested that much more fundamental reforms are needed. One such reform could be establishment of an elite force of professional maintenance technicians who would learn their craft in the traditional apprentice-to-journeyman career path. A core of senior mechanics would have rank and pay commensurate with their experience, but they would not (in contrast to normal Army policy) be burdened with command responsibilities. Such a work force could be smaller than the present one because of increased efficiency, but may need more centralization and tighter management control.

Research is needed to quantify the costs and benefits of alternative approaches to the current maintenance organization and training setup. The Army Master Mechanic Program[4] seems to be a positive contribution in this direction.

Technology could have a major role to play here: the development of training and testing aids received the enthusiastic endorsement of survey respondents, not only for schools (for which a few maintenance training simulator systems are being developed), but also for OJT and refresher training programs (see App. B, p. 57, and App. C, p. 3). Of course, the OJT process would have to be fundamentally revised to take advantage of such technological innovations. It is interesting to note that although technology has vastly improved the capability of combat systems in the last twenty years, it has contributed almost nothing to training personnel to operate or support those combat systems.

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[4]See *Master Mechanic Program*, Master Mechanic Task Force, U.S. Army Logistics Center, Fort Lee, Virginia, March 1978.

The opportunity may now exist to remedy this situation through innovative technology--in such forms as driver training vehicles and simulators, maintenance training simulators, and management training tools--to help bridge the huge gap between training requirements and available resource levels. OJT using such devices might have to be conducted at a Table of Distribution and Allowances (TDA) civilian facility, since it appears to be the only location where controlled, broad-range maintenance is conducted in a consistent manner. Students would have to be motivated to accept such training--questionnaire respondents warned against simply "dumping" new training or training aids on personnel under present conditions. Training should be oriented toward wartime as well as peacetime maintenance operations. At present, Reserve Component personnel often do not have the equipment they are expected to support in wartime available to work on in peacetime, and even Active Army units seldom have the chance to conduct repairs oriented toward combat conditions, which include cannibalization, friage, management of recovery assets during surge periods, diagnosis of combat damage, in-field repair parts ordering and transfer, and other procedures dissimilar to peacetime practice. High technology training aids could simulate at least some of these conditions.

Finally, advanced technology could provide refresher training that could be brought to the units, obviating the need to send personnel away to schools for such courses. Respondents indicated that unit leaders are loath to let go of their good mechanics for even a few days, and the personnel they allow to go to refresher or upgrade courses are often not those likely to benefit from them.[5]

1.3 Periodic/Preventive Maintenance (PM)

A major procedural problem is the failure of crews and mechanics to perform periodic maintenance on vehicles in accordance with technical manual schedules (see App. B, pp. 11, 12, 62). Preventive

[5]An instructor from such a school at Vielseck, Germany, put it bluntly (in a post-survey interview): "All we generally see are turkeys and short-termers."

maintenance services unlikely to be performed on time include crew basic services and BDA checks, lubrication orders (LOs), and Organizational quarterly, semiannual, and annual (QSA) services.

The implications of the lack of PM, which seems to hold for almost all units in the sample, are serious: filters and lubrication oils go unchanged, minor mechanical problems are undetected and go on to cause major failures, batteries run down and result in vehicles that cannot be operated "at a moment's notice,"[6] and the vehicle's basic health and capability to perform a full mission profile remain unknown factors to fleet managers and combat commanders.

Primary reasons given for the lack of PM are a lack of supervision and command, poor training in PM procedures, failure to properly schedule (and enforce) PM periods and vehicle dispatch controls, and poor personnel attitude and motivation. A major contributing factor to the poor attitude of many operators is the absence of any feeling of responsibility for vehicles; operators generally have no long-term one-on-one assignments to vehicles, and are not held really accountable for their condition.

Preventive maintenance schedules themselves (as stated in TMs and directives) are generally rated as adequate in Active Army units; USAR respondents feel that schedules in Reserve components should be reduced somewhat. A strong recommendation was made that PM should be based more on actual usage than on arbitrary time intervals; some low-usage vehicles occasionally receive more PM than they actually need. Unnecessary PM of this type is often sloppily performed, and may do more harm than good as a result of hastily torqued bolts and screws, improperly lubricated wheel bearings, and so on.

1.3.1. Respondents' Recommendations. Enforcement of required operator PM could be improved by more one-on-one assignment of operators to vehicles (see App. B, pp. 44, 45). Every attempt should be made to foster personal responsibility by adhering to such assignments,

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[6]The battery problem may be more serious than it would seem at first glance. Some respondents noted that units were going through at least one set of batteries per vehicle per year. A large-scale mobilization could result in an acute shortage of batteries.

even if they contravene efficiency measures.[7] Checking the initial and continuing vehicle condition after assignment will require skilled and involved supervisors, including section leaders. Stringent dispatch control must also be exercised--vehicles should not be released for use until PM and BDA services have been performed. Sufficient time for BDA checks should be scheduled for each driver.

Motivation for mechanics to perform PM will also require the presence and involvement of trained supervisors. Preventive maintenance periods should be definitely scheduled, and attendance made mandatory. Personal responsiblity for upkeep of each vehicle could also be strengthened by assignment of mechanics and crews to a specific vehicle or group of vehicles, with team assignment of PM duties.

1.3.2. Author's Comments. It would be helpful if the failure of operators and mechanics to perform preventive or periodic maintenance could be quantitatively described; if it is as serious as respondents allege, it casts doubt on the health and combat readiness of the vehicle fleet, since readiness indicators for the fleet assume that PM schedules have been met in accordance with official doctrine.

Means should be explored of directing more command emphasis on the scheduling and enforcement of PM for vehicles. A possibly fruitful area for technology is the development of easier means of monitoring PM performance and the continuing health of the vehicle fleet. Future vehicle development program managers should also consider placing more emphasis on components that require little or no periodic maintenance, or that are self-checking. It should not be assumed, however, that reducing the number of PM services that personnel must perform will automatically lead to compliance.

1.4 Diagnosis and Diagnostic Equipment (TMDE)

The critically important problem relating to Test, Measurement and Diagnostic Equipment (TMDE) is that it is normally not used (see App. B, pp. 16, 17). The major reasons are lack of training in

[7] One-on-one assignment may make proper rotation of vehicles very difficult, for example, and may result in vehicle disuse when the driver is absent from duty.

diagnosis and of enforcement of approved troubleshooting procedures. In general, there is an accepted *modus operandi* of "diagnosis by replacement"--troubleshooting by trial-and-error substitution of components.

Personnel are generally uncomfortable with present TMDE, partly because of fear of damaging the equipment by reverse hookup or other errors, though the greatest discomfort seems to be from lack of understanding how to use it. In addition, technical manuals on troubleshooting procedures are often not at hand, and are hard to comprehend in any case. Supervisors apparently do not enforce use of TMDE or troubleshooting "by the book;" some respondents indicated supervisors may actually discourage use of TMDE because they themselves are not familiar with it.

Put another way, there seem to be two basic problems relating to TMDE from the workers' point of view: (1) mechanics are unconvinced that use of TMDE would produce results more quickly and easily than trial-and-error, i.e., that TMDE is practical; and (2) mechanics are untrained in diagnostic concepts and use of diagnostic tools--they have no practical means of gaining experience with TMDE and becoming "comfortable" with it. These two shortcomings critically affect many other aspects of the maintenance process. The procedure of repair by replacement is most common for fuel, electrical, and electronic system components (generators, carburetors, batteries, and starters), which results in waste of components, because the original is seldom reinstalled when its replacement fails to clear up the problem. The strain this procedure places on the repair parts system is significant: the estimated percentage of certain types of parts ordered because of improper diagnosis is over 35 percent, i.e., 35 percent of parts replaced in electrical, fuel, and other subsystems were in fact still good (see App. B., pp. 38, 62).

The quality of the diagnostic equipment itself is judged to be a lesser problem. The equipment is not always available, chiefly because of outages due to calibration and repair. In some cases TMDE is locked up because personnel or supervisors are afraid the equipment may be damaged. In general, although TMDE is considered to be bulky,

complicated, and slow, it is judged adequate for use by well-trained "ideal" personnel. It may be inappropriate for the personnel actually at hand. An oft-expressed opinion was that "TMDE appears to be adequate, but since it's not used much, it's hard to tell."

1.4.1. Respondents' Recommendations. Accurate troubleshooting by mechanics requires far more active and skilled participation from supervisors and officers than is now the case (see App. B, pp. 44, 45). Effective troubleshooting will mean refresher training for the workers--it could probably not be done with the skills they presently have. Once trained, personnel should be required to follow troubleshooting guides at all times.

A new battalion-level TO&E position should be established for a "master diagnostician." Such a person would be a senior, skilled mechanic cross-trained on the tracked or wheeled vehicles in the battalion; he would be capable of conducting troubleshooting and control of parts ordering. Supervisory and administrative burdens on this person should be kept to a minimum; he should be directed to work as a technical mechanic only.

Faster, more comprehensive integrated TMDE should be developed for the master diagnostician to make maximum use of his time and skill. Such test sets should be permanently assigned, not checked in and out. Future TMDE for normal Organizational level mechanics, on the other hand, should be simplified and reduced in scope; use of red-green-amber lights or similar human engineering to make test sets easier and more "comfortable" to use was strongly suggested. Built-in on-board diagnostic equipment was requested for operators of the expensive and complex vehicles in the fleet, especially tanks. Such built-in indicators should not only display faults to operators at the time they happen, but also record such faults, so that operators cannot simply ignore the information.

Finally, an emphatic request was made that future TMDE either require little calibration (due to redundancy or other reliability features) or be self-calibrating (or testable by simple, local means), to increase availability of the equipment and user confidence in it.

1.4.2. Author's Comments. Most maintenance personnel apparently do not use TMDE and do not follow approved troubleshooting procedures. Diagnostics appears to need more human factors research than it has received in the past. Survey respondents indicated that future technological developments in TMDE should follow two directions: (1) much easier diagnostic tools for the normal mechanic that would allow simple red-green-amber type determinations, and (2) more comprehensive, integrated TMDE for use by a small group of specialists. Some means of monitoring whether the TMDE had in fact been used for troubleshooting should be included, lest the new TMDE sit gathering dust on shelves just as its predecessors now do. Since the training level in TMDE use appears to be very low, it may be beneficial to incorporate interactive features into future TMDE that would assist in training the mechanic and assure that he follows step-by-step troubleshooting procedures.

Technological aids to help vehicle operators in troubleshooting should take into consideration the "people problems" identified by respondents. Since indications of vehicular trouble from built-in test equipment (BITE) on vehicles (such as temperature and pressure gauges) are often either ignored by operators or are incorrectly reported to mechanics, it may be beneficial to develop "flags" (indications that a dangerous problem has been signaled by the BITE) and automated printouts for future on-vehicle diagnostic systems (see App. B, p. 55, and App. C, p. 2).

Future TMDE developmental research should address means of increasing the reliability and ruggedness of test sets through solid state components, redundancy, or fault-tolerant design techniques, to reduce TMDE downtime and allay mechanics' fears about damaging the equipment. Finally, some new types of test sets may be required by DS and GS units if they are to inspect vehicle components before accepting them for repair or overhaul; results from such testing could not only save much time unnecessarily spent in repair, but could provide valuable feedback to maintenance supervisors on how many of the components that mechanics identified as faulty and replaced were in fact still good.

1.5 Vehicle Operation: Operators and Crews

The main problems regarding vehicle operation concern vehicle operation, performance of preoperation checks and PM services, and detection and reporting of vehicle faults (see App. B, pp. 23, 24, 62). Poor PM has already been addressed.

Improper operation of vehicles is considered a very serious problem. Both intentional abuse (because the operator does not care about the vehicle's condition) and unintentional misuse (due to lack of proper training) of vehicles takes place frequently.

Improper operation includes hot-rodding on and off the road, over- and under-revving engines, improper shifting, overheating engines, operating with low fluid levels, and improper shut-down of diesel engines. Operators drive this way through ignorance or because of "youthful high spirits;" they continue to do so because of (1) improper training and licensing procedures, (2) poor motivation on the part of the operator, often due to lack of one-on-one vehicle assignment and enforced responsibility, (3) inability to monitor vehicle misuse/abuse, (4) poor dispatch control, and (5) unskilled and unmotivated supervision.

A number of respondents pointed out that many of the failures on vehicles (especially new vehicles) are obviously due to abuse, and include burned-out clutches and brakes, overheated and seized engines, and ruined transmissions.

Unintentional misuse of vehicles, on the other hand, is generally due to poor training. Drivers lack proper training in even basic vehicle operation. Most units do not provide the time for either initial driver training or for update classes to increase proficiency. Respondents stated that licenses for wheeled vehicle operators in many units were issued "after a quick tour around the parking lot." Many tracked vehicle operators are not much better off, having had only a few hours of driver's training.

The neglect of drivers in performing before-during-after operation (BDA) checks, sometimes collectively called pre-op checks, also has serious overtones. Leaking or absent air filters, low or contaminated coolant fluid, low lubricant levels, and similar conditions that

go undetected may cause mission abort as well as costly damage. Although poor training in performing pre-op checks is a definite contributing factor to this situation, lack of operator motivation appears to be the main cause.

Even those vehicle faults that are detected before vehicle failure are generally not properly reported to the mechanics for maintenance action. Again, this can be a result of either lack of training or motivation. Untrained operators cannot adequately identify a fault condition or describe it for the mechanic on the 2404 form. Unmotivated operators will ignore even an obvious fault indication such as a red light on the dashboard because of a "let someone else report it and get involved" attitude or because of a general dislike for paperwork. Unfortunately, the military driver generally has not the opportunity for verbal feedback from the mechanic that his civilian counterpart does. The only means he has of reporting faults is by filling out a form, which he dislikes, and which allows for no feedback. Not all drivers are limited in this way--some units have scheduled or encouraged driver-mechanic communication sessions, but they appear to be the exception rather than the rule. There is certainly no Army-wide policy of operator-mechanic post-op debriefing, as there is in the Air Force, for example.

A general motivational factor that affects many operators, especially wheeled vehicle operators, is that they have nothing to gain by having a vehicle in operating shape. Since vehicle operation is often considered an additional detail rather than a primary duty, and since personal responsibility is not effectively enforced, many operators are unconcerned whether the vehicles run or not. Occasionally the incentives may be perverse, e.g., operators may get free time if vehicles *do not* run.

Overall, operators were judged as poorly trained, tested, supervised, commanded, and motivated.

1.5.1. Respondents' Suggestions. Operators first and foremost need improved training, not only in schools, but especially on post. New operators should receive hands-on training as it is described in the books (but as it is seldom conducted; see App. B, p. 47).

Operators who are already licensed should receive refresher training, and should improve their skills by learning to operate vehicles during simulated combat, on difficult terrain and in poor weather, while towing trailers, and so on. Much of this training should not be left up to the unit, but should be conducted at post level. Training aids such as driving simulators in schools are commendable, but they must also be available at the post or unit level.

In addition to driving training, operators and crews need better training in filling out forms and in performing crew-level maintenance. Regular interaction between crews and mechanics, such as weekly meetings and team assignments for PM chores, may increase operator skills in this area.

Finally, the problem of motivating operators needs to be given high priority. Responsibility for vehicles must be established and enforced. Conscientious operators should be rewarded and negligent operators disciplined. Specific means of applying the "carrot or the stick" approach include driver's badges, a small driver's bonus payment that would be taken away if the vehicle was down, Reports of Survey to make the driver pay for damage due to obvious negligence (this means is now seldom used), and overtime duties to aid mechanics in getting inoperative vehicles running again. Some of these approaches would be difficult to enforce in practice because (1) some operators would be assigned new vehicles while others would be driving "clunkers," (2) it is often hard to prove that a vehicle is down because of operator actions, and (3) the operator may be frustrated in his efforts to help get the vehicle running again because of ineffective mechanics or long waits for repair parts. Driver monitoring devices such as tachygraphs are recommended to help establish how a vehicle was handled, *if* such devices did not pose additional administrative chores for supervisors.

1.5.2. Author's Comments. Abusive operating procedures that cause the most damage to the vehicle fleet need to be identified and described with hard data. The Army-wide use of a small, reliable on-vehicle condition monitor system should be investigated; the success of such a system may depend on whether it adds to or subtracts from

the supervisory burden, and whether leaders are motivated to follow up on results. Entry of an operator's identity number into such a system could aid in strengthening feelings of personal responsibility for vehicle operating condition.

1.6 Vehicle Status Reporting

The sixth problem area of major proportions concerns maintenance data forms and reports. Much of the data are intentionally incorrectly entered or omitted (see App. B, pp. 35, 36). Forms containing unreliable information include the DA2404 (Equipment Inspection and Maintenance Worksheet), DA2406 (Materiel Readiness Report), DA314 (Preventive Maintenance Schedule and Record), DA2408-1 (Equipment Daily or Monthly Log), and DA2408-14 (Uncorrected Fault Record). Forms often not filled out at all (by the person responsible) include the DA2404 and DA2408. Such empty forms are often "brought up to date" just before an inspection.

Since the basic maintenance and equipment status reports tend to be unreliable, it should come as no surprise that consolidated management records depict an inaccurate fleet maintenance history, and that unit status or operational readiness (OR) reports give an erroneous indication of the actual fleet status.

A problem of lesser magnitude is the nature of the forms. Although almost all maintenance forms are appropriate for what they measure, the total paperwork burden is excessive.

1.6.1. Respondents' Recommendations. Improving the accuracy of data entered on maintenance forms should receive priority attention at all units. Continual inspection of forms data and a willingness to follow up on those entering false data are necessary. Spot checks should be made not only by supervisors and the unit commander but by division or post inspection teams. Operational readiness (OR) reports should not be considered commanders' "report cards," and units should be encouraged to "tell it like it is," secure in the knowledge that honest vehicle status reporting does not reflect adversely on an officer's record (see App. B, p. 49).

A review of maintenance forms and records should be initiated to determine which are nonessential and not critical management tools. Forms found unnecessary should be eliminated to reduce paperwork; innovative methods to reduce paperwork should be investigated (a simple example is the use of plastic credit-type cards to enter recurring data on forms).

1.6.2. Author's Comments. A fundamental problem of the entire maintenance system is the lack of reliable basic data, including data on operating procedures, vehicle condition indicators, maintenance costs, manpower utilization rates, and vehicle readiness rates. Most maintenance reports rest on data entered by operators and mechanics, and these data tend to be invalid.

Technological research should attempt to reduce a basic source of error by seeking to minimize personnel inputs. New verification techniques to check data at various entry levels may also be necessary.

A problem for supervisors and managers is the size of the paperwork burden, which may reduce their availability for ground-level management of the motor pools. Reorganization of administrative loads should be investigated; shifting the administrative burden from at least some of the leaders could allow more active involvement with personnel in work areas on a day-to-day basis. The possibility of reducing administrative workloads by technology innovations should be studied. Increased automation of data in the existing system is probably contraindicated, as it would only lead to more elegant manipulation of invalid input data.

1.7 Management and Supervision

Most commanders do not display sufficient interest in maintenance operations or emphasize maintenance performance (see App. B, p. 40). (Commanders who are exceptions to this rule tend to have strikingly different maintenance programs.) Neither senior nor junior officers are often in the shop area or are actively involved in maintenance in a consistent manner. The role of the commander is critical; when a new commander shows interest in his maintenance effort, maintenance improves immediately. Conversely, good unit maintenance without a

commander's active support is unlikely. Many respondents quoted General Bruce Clarke's dictum, "An organization does well only those things the boss checks."

One facet of the problem of command inattention is the lack of involvement of junior officers and noncommissioned officers in the conduct of PM periods. A major reason leaders are not in the motor pool is their administrative burden--supervisors are absorbed in paperwork and other duties whose results may have greater visibility or gain more recognition than the day-to-day conduct of operations maintenance.

Another management problem is the lack of effective incentives to motivate personnel. Although positive incentives for good performance such as the Driver's Badge or the Mechanic's Badge exist, they are almost never awarded.[8] The general feedback from respondents is that maintenance personnel (especially mechanics) feel treated like second-class citizens, inferior to personnel in combat service or in "clean" jobs; they feel they receive little command recognition for positive achievement.

An additional obstacle to effective management is the manner in which Standing Operating Procedure (SOP) listings are utilized in most units. Almost all units have an SOP, but it is generally not disseminated or posted (in the form of wall charts, etc.) or made generally meaningful to maintenance personnel. A typical SOP is characterized as an often-outdated document that resides in the commander's drawer until inspection time, at which moment it temporarily surfaces. This failure to express the commander's basic maintenance policy and objectives results in the loss of basic management tools and working criteria for the unit as a whole.

Of the maintenance problems that have been covered in this section respondents rated poor management and supervision as having the greatest negative impact on maintenance, i.e., as contributing the most to maintenance problems, followed by personnel training and motivation.

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[8]Several motor officers in a post-survey interview indicated they had heard of a Mechanic's Badge, but had never actually seen one.

1.7.1. Respondents' Recommendations. Stronger and more effective management emphasis and priority on maintenance is called for, from corps and division commanders on down (see App. B, p. 51). Improvements in inspection are necessary--present inspections suffer from an inability to thoroughly examine more than a small sample of vehicles.

Commanders should visit the motor pool more often and check on the presence and involvement of their NCOs. Programs to evaluate and train supervisors in many facets of their jobs (e.g., troubleshooting, expertise at teaching OJT) need initiation and follow-through by commanders. Commanders, in turn, need better courses in maintenance management.

Occasional checks and follow-ups on maintenance records, plus a supportive attitude encouraging personnel to "tell it like it is" should increase the validity of the data and its usefulness for management reports. Data that are not acted on by management should no longer be collected.

Preventive maintenance periods should be definitely scheduled, and attendance made mandatory. Commanders and supervisors should establish and then follow up on personal responsibility of maintenance personnel for the vehicles in their units.

The motivation of mechanics would be improved by the commanders' awarding badges and special insignia, and by other types of command recognition. In post-survey interviews, battalion maintenance officers agreed that such awards would probably get results out of all proportion to the time and costs involved in giving them. Rewards of this type should go hand-in-hand with a generally upgraded attitude regarding maintenance. Several respondents from different commands used almost the same wording in their to-the-point recommendation: "Treat the mechanic as a technician, not as a grease monkey or second-class citizen."

More emphasis should be placed on holding negligent mechanics and drivers liable for damage arising from poor work; however, better instruments for doing this are needed, as Reports of Survey and similar applications of the military justice system are difficult to put into practice.

Standing Operating Procedures should be made simple, mechanic-oriented guidelines that are realistic expressions of the commander's maintenance policy. They should be promulgated in the form of wall charts, checklists, and motor pool bulletins, and should be updated upon change of command.

1.7.2. Author's Comments. Management emphasis on maintenance appears to be generally inadequate and inconsistent, not because commanders are negligent or do not care about the status of their vehicles, but because the ever-increasing diversity, complexity, and number of vehicles have created a growing demand for management attention and expertise at a time when other demands on the commander's time have not commensurately decreased. The possibility of future technological developments to aid the vehicle fleet management burden should be investigated, including faster and easier vehicle inspection capability (perhaps even remotely), vehicle fleet status displays, and management information systems of improved accuracy and timeliness.

2. SECONDARY PROBLEM AREAS

Four problem areas were judged by respondents to be of secondary importance to the maintenance system. This study, of course, is an evaluation of average or Army-wide conditions; for specific units or geographic locations, these problems may be of very high significance.

2.1 Facilities

Inadequate facilities limit productivity and cause morale problems (see App. B, pp. 18, 19). Conditions in USAREUR were reported as significantly worse than those in CONUS. A shortage of available space--for work, storage, and shop offices--was the most frequent complaint, followed closely by lack of proper heating and ventilation, improper lighting, and a lack of grease pits, racks, and hard stands in the work area. The design of many shops was judged as poor, with little user feedback incorporated into the layouts. A shortage of labor-saving devices such as hoists and lube stations and the absence of latrines and battery service areas in some shops may cause much wasted motion; the lack of shop offices may contribute to the absence of supervisors in the work area.

Facilities for conducting repairs in the field are also poor--there is no provision for adequate shelter from the elements, and there is inadequate provision for lifts, power and special tools, repair parts, and lights and electric power. These shortages contribute significantly to the general failure to repair breakdowns in the field during and after field exercises, a practice that robs personnel of the experience they might otherwise gain in front-line maintenance procedures.

Recommended solutions include improved heating, lights, and storage space, especially by USAREUR respondents, some of whom complained of buildings constructed prior to World War II. Shop layouts should include more user input, and their design should be updated for the present vehicle mix (see App. B, p. 46).

Authorization of repair vans for organizational maintenance sites and for contact teams (small detachments of mechanics that visit forward maintenance areas) are requested. Field repairs need provision of a quick-erect tent, perhaps similar to the inflatable ones of the field hospital units; presently available tents take one to two hours to set up. More portable storage buildings may be necessary for maintenance activities under field conditions.

2.2 Extended Storage

Over half the Army's vehicles are in storage. The main problems resulting from long-term storage of vehicles are deterioration due to rust, drying out (especially rubber parts), and rotting (see App. B, p. 21). Such deterioration affects not only the chassis or automotive parts of vehicles, but also the weapons and fire control systems. Deterioration occurs because many storage facilities offer inadequate shelter, and because in-storage inspection and maintenance services are not performed on schedule. In addition, vehicles are not thoroughly checked and properly prepared for issue when they come out of storage.

Opinion on the extent and seriousness of this situation varies from unit to unit. This may be because different areas have different storage facilities and procedures or because (as some respondents

indicated) many problems with a previously stored vehicle do not surface until the vehicle has been run for some time, thus making any such correlation difficult.

Recommended solutions included review of the entire process of storing, servicing, and deprocessing vehicles. Such a review may find that manpower requirements for the storage process are much higher than is now allowed for, and that post-storage equipment problems are much more pervasive than is generally assumed. Inspection and periodic maintenance of vehicles in storage should also be improved (see App. B., p. 46).

Some technical solutions may also be possible, e.g., longer-lasting vehicle seals.

2.3 Parts Availability

That availability of spare parts can be a problem should surprise no one (see App. B, pp. 28, 29). The response to the question on this topic was mixed, however, and exhibited high polarity. Thus, though the overall response places this problem in the "secondary importance" category, this is an average between units whose parts supply systems seem to be working and units who suffer serious delays.

The main reason for parts delays appears to be improper ordering procedures (because of unskilled clerks, confusing changes to stock numbers, and unavailability of parts manuals), lack of follow-up procedures, lack of local stockage, and procurement lags. Items that take long to order in most units are engines, batteries, generators, and starters.

Overall, the design of the repair parts supply system was judged adequate, but the system is slow in actuality because procedures are not properly followed.

Recommended solutions included improving availability of repair parts by employing better trained PLL clerks (see App. B, p. 48). Some increases in PLL or ASL stocks may also be necessary for certain units. The demand on the parts system could be reduced by skillful diagnosis and better care of parts such as batteries.

2.4 Publications

Maintenance personnel tend not to use technical manuals and similar publications, even when they are available (see App. B, pp. 31-33). The publications are hard to read, supervisors do not require their use, and many mechanics seem to think it unnecessary to use or refer to standard texts; they prefer to "play it by ear." Maintenance procedures are nonstandard as a result.

The usefulness of existing TMs as reference books for troubleshooting routines was generally upheld, though specific troubleshooting schematics (e.g., for the M60A1) were criticized, as was the tendency for some manuals to recommend replacement without adequately checking the component to ensure its unserviceability. Lack of availability of publications is also a common problem. The documents most often unavailable are current TMs, operator's manuals, and Lubrication Orders (LOs). Documents are unavailable because units have not established proper publication "pinpoint" (direct distribution) accounts, clerks are unfamiliar with ordering procedures, no one is assigned responsibility for maintaining technical libraries and following up shortages (probably the most important reason), and because intra-unit distribution is poor--battalion centers receive publications, but they somehow go astray before reaching the company motor pool.

Feedback from the units to the originators of maintenance publications is a problem of medium significance because (1) users at the unit level are not motivated or encouraged to pass comments or corrections up the line, (2) mechanics and drivers tend to be poor writers, and dislike written communications in general, and (3) originators do not visit the field often enough.

Recommended solutions include rewriting TMs and LOs in a simpler, more understandable format, with easier troubleshooting guides and much greater use of illustrations (see App. B, pp. 48, 49). Use of publications should be mandatory. Lubrication Orders should feature more standardized intervals for similar groups of vehicles and LOs should be combined with TMs. Authors of technical manuals and similar publications should visit the field more often to get better feedback from users.

3. MINOR PROBLEM AREAS

The following aspects of the maintenance system do not have serious or consistent problems, and are touched on only briefly. Whereas some improvements in these areas are desirable, they would probably not result in significant enhancement of the maintenance system or the readiness of the vehicle fleet.

3.1 Tools

Tools, on the whole, are adequate in number and type authorized, although availability of tools is sometimes a problem (see App. B, p. 14). The major reasons for unavailability of tools are poor tool control (tools lost or tool room locked) and slow replacement of broken or missing tools.

3.2 POL

Petroleum, oil, and lubricants seem to be of reasonable quality. When POL problems occur they generally consist of contamination due to local unit storage conditions: oil drums left outside uncovered, dirty storage tanks that have not been drained and cleaned, and too much water in fuel (see App. B, p. 30).

3.3 Vehicle and Parts Quality and Design

The group of questions dealing with vehicles sought to explore the question of whether most vehicle failures were brought about by the operations and maintenance cycle or whether they were intrinsic to the vehicles themselves, i.e., whether the basic problem "came with the vehicle" owing to poor design or manufacture (see App. B, pp. 20, 22, 29).

In general, whereas there were some complaints in specific areas, vehicle design and production received a vote of confidence. The vehicles *were* faulted on some maintainability aspects, especially poor access to items such as filters, lubrication points, fuel cells, starters, and some electrical components. There was also some dissatisfaction with the increasing complexity of newer vehicles, with comments to the effect that these seemed to be designed for repair by

specialized technicians, rather than with the manpower skill level that actually exists.

Overhauled and rebuilt vehicles and components were generally considered adequate, with the exception of M35 trucks rebuilt in Taiwan, some combat vehicle engines (M113, M60), some rebuilt electric components, and M35 air hydraulic cylinders.

Vehicles are apparently not normally damaged in transit to the units.[9] Inspection and preparation before issue to the unit, though considered adequate, may need additional attention--the workload generated by these tasks is apparently large and not always properly provided for. The Army may not receive proper feedback on items of issue that arrive in unserviceable shape because units fail to fill out equipment inspection reports (EIRs).

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[9]There were indications, however, that vehicles or components being sent out for repair from the units, e.g., engines going to depot for rebuild, may sustain serious damage due to improper packaging and stripping of usable items by the units.

IV. SOME COMMENTS AND CONCLUSIONS

The primary purpose of the Rand survey was to elicit a frank description and appraisal of problems in the Army maintenance system. The survey effort was successful in this regard, and the results have been described in the preceding section. It is beyond the scope of this report to try to pinpoint the basic causes of these maintenance problems or to formulate specific suggestions for improvements. However, it seems appropriate to comment on some of the insights the author has gained as a result of the survey questionnaire effort.

One major finding is the dominance of manpower-oriented problems. The survey instrument was oriented toward finding technical problems, but it quickly became clear that technical issues took a back seat to "people problems." Management, training, and motivation head the list of problem areas (see App. B, pp. 42, 52). Aspects of the maintenance system such as diagnostic equipment or data forms are generally not considered to be problems per se, but lead to problems in the way they are (or are not) used. These manpower-oriented problems appear serious and deep-seated, and may be degrading the support (and thereby the combat) capability of Army units to an extent that is not generally appreciated. Attempts at quick fixes to any single aspect of these major problems are probably unlikely to provide any long-term improvement, given their seriousness and extent and the complex incentives (many unrelated or even opposed to production-oriented efficiencies) that permeate the system. For example, a simplistic call for more command emphasis could result in merely more paper maintenance and falsified operational readiness reports *if* other factors (such as the commanders' ability and willingness to check up on such reports) remain the same. Attempts by commanders for comprehensive solutions have often been successful at the individual unit level; applying such solutions in a consistent manner across the Army may well be a Herculean task. If such Army-wide solutions are not deemed possible (and if manpower-related problems are as serious as

the survey indicates), it may then be necessary to look at alternatives to (1) the present vehicle fleet (which tends toward complicated, expensive, high-capability vehicles), or (2) present wartime maintenance policies (which demand a complicated system of interaction between the different maintenance levels, and tend to rely primarily on the skills of lower-echelon mechanics), to bring support requirements in line with realistic personnel capabilities in the system.

A second major finding is the lack of reliable basic data in many facets of the maintenance system: how vehicles are operated, what makes them fail, how often PM services and repairs are conducted, how long repairs take, and so on. Much of the available data are invalid, because they are either poorly kept or falsified (see App. B, pp. 35, 36). As a result, managers do not have reliable descriptions of the health of their vehicle fleets, or of work undertaken to maintain that fleet. Planners do not have sound data on which to base staffing requirements or maintenance policy decisions. And vehicle and support equipment developers do not have the kind of information they need to tailor their designs to actual field conditions. Improvements in future data gathering efforts will come about only if the training and motivation for the generators of much of the data--vehicle drivers and mechanics--are radically improved, or if these sources can be largely bypassed by automatic data gathering systems.

In summary, this survey indicated that fundamental improvements in the Army maintenance system are urgently needed. Technology could have an important role to play in such improvements, especially in such areas as training and data gathering. To bring this about, technology developers must take a realistic account of the existing maintenance system and the capabilities and motivating factors of its personnel, probably much more so than has been done in the past.

Appendix A
GLOSSARY

APC	Armored Personnel Carrier
AR	Army Report
ASL	Authorized Stockage List
ASOAP	Army Spectrographic Oil Analysis Program
AT	Annual Training (for Reserve Component)
BDA	Before, During and After operation vehicle maintenance checks
BII	Basic Issue Item
BITE	Built-In Test Equipment
BN	Battalion
Cdr	Commander
Cmd	Command
CMMI	Command Maintenance Management Inspection (team)
CO	Commanding Officer
CONUS	Continental United States
DA	Department of the Army
DARCOM	U.S. Army Development and Readiness Command
DIO	Director of Industrial Operations
DIV	Division
D/L	Deadlined (vehicle)
DS	Direct Support (maintenance level)
DX	Direct Exchange (of faulty components for serviceable ones)
EIR	Equipment Inspection Report
ESC	Equipment Serviceability Criteria (report)
FM	Field Manual
FMT	Field Maintenance Technician
FORSCOM	Forces Command
FSC	Fire Support System (of a tank)
FSN/NSN	Federal Stock Number/National Stock Number
FTX	Field Training Exercise

GS	General Support (maintenance level)
GSA	General Services Administration
IAW	In Accordance With
I.G.	Inspector General
Ign	Ignition
INF	Infantry
IROAN	Inspect and Repair Only As Necessary
LO	Lubrication Order
LVCT	Low Voltage Circuit Tester (TMDE set)
MAC	Maintenance Allocation Chart
MAIT	Maintenance Assistant and Inspection Team
MET	Maintenance Evaluation Team
MOS	Military Occupation Specialty
MTBF	Mean Time Between Failure
NCO	Noncommissioned Officer
NIS	National Inventory Stock Number (of repair work)
NORS	Not Operationally Ready, Suppy (i.e., down for lack of repair parts)
OER	Officer Effectiveness Report
OJT	On the Job Training
OR	Operational Readiness
ORG	Organizational (maintenance level)
PCS/ETS	Permanent Change of Station/End of Time of Service
PLL	Prescribed Load List (parts inventory)
PM	Periodic or Preventive Maintenance
PMCS	Preventive Maintenance Checks and Services (to be performed by the crew)
POL	Petroleum, Oil and Lubricants
POV	Privately Owned Vehicle
Q	Quarterly (PM services)
QC/QA	Quality Control/Quality Assurance (in manufacture)
QSA	Quarterly, Semiannual and Annual (PM services)
RC	Reserve Component
REDCON	Readiness Condition
ROID	Report of Item Discrepancy

SOP	Standing Operating Procedure
SQT	Skill Qualification Test
STE/ICE	Simplified Test Equipment/Internal Combustion Engine (integrated TMDE set)
SVCS	Services
TARCOM	U.S. Army Tank Automotive Readiness Command
TDA	Table of Distribution and Allowances
TK	Tank
TM	Technical Manual
T/M	Transmission
TMDE	Test, Measurement and Diagnostic Equipment
TOE, TO&E	Table of Organization and Equipment
TRADOC	Training and Doctrine Command
UCMJ	Uniform Code of Military Justice
UM	Unscheduled Maintenance
USAR	U.S. Army Reserve
USAREUR	United States Army, Europe
VOM	Volt OHM Meter (TMDE set)

Appendix B
THE QUESTIONNAIRE FORM

INTRODUCTION

This appendix contains the questionnaire survey form; statistical data on results and a sample of comments have been added to the form. "Filled-in" data are printed in italics so that the reader can differentiate them from the questionnaire form. Comments on the five sections of the questionnaire are presented below.

Section 1 (Maintenance Background)

The questions and filled-in answers on p. 2 of the questionnaire are fairly obvious. Answers to item 1.7 were obtained, but were not computed as they make no statistical sense.

Section 2 (Maintenance Problem Areas)

The instructions given in questionnaire pp. 3 to 5 should clarify the purpose of the questions and the meaning of the filled-in answers. Over 90 percent of respondents answered each of the main questions in this section. Where possible, the total percentage of respondents answering a question a certain way is given in the filled-in italic print. Elsewhere, the most commonly given answers are indicated.

Section 3 (Possible Solutions to Maintenance Problems)

Many specific suggestions appeared in responses to this section that could not be included in the filled-in form. Again, only a *sample* of the most common responses is presented in the answer spaces. Responses that were given by over half the respondents are high-lighted with an asterisk to indicate a high similar-response rate.

Section 4 (Diagnostic Aids)

The averages of respondent evaluations are listed in italics to the right of the numerical scale.

Section 5 (Maintenance Data Estimates)

Only personnel with appropriate background were asked to respond to this section. Between 25 and 50 percent of respondents answered the questions in this section; when less than 25 percent answered a particular question (as with 5.1.13), the question was considered unanswered for purposes of this report.

SURVEY QUESTIONNAIRE FOR VEHICLE MAINTENANCE SPECIALISTS

June 1978

[1]

INTRODUCTION TO QUESTIONNAIRE

This questionnaire has been prepared by the Rand Corporation for the Advanced Research Projects Agency (ARPA) of the Office of the Secretary of Defense (OSD) in support of a current study of requirements for future generations of advanced Test, Measurement and Diagnostic Equipment (TMDE) for Army ground vehicles.

The purpose of this questionnaire is to elicit the opinions of maintenance specialists in identifying: 1) the nature and relative importance of ground vehicle maintenance problem areas; 2) plausible solutions that could be applied to these problem areas; and 3) problem areas for which future generations of TMDE could be most helpful.

All questions refer only to four vehicle types: 1/4-ton trucks (M151 series); 2 1/2-ton trucks (M35 series); Armored Personnel Carriers (M113 series); and tanks (M48 and M60 series).

The questionnaire covers various aspects of vehicles, maintenance resources (personnel, equipment, facilities, supplies, and information), and use factors (policies, procedures, organizations) to determine what problems are significant in each area and what solutions may be feasible. Questions are presented in five different sections:

- Section 1 (Maintenance Background) requests a short summary of your vehicle maintenance experience.
- Section 2 (Maintenance Problem Areas) is concerned with the nature and significance of various maintenance problems.
- Section 3 (Possible Solutions) asks how maintenance problems can be reduced.
- Section 4 (Diagnostic Aids) deals with selected general concepts for advanced diagnostic aids.
- Section 5 (Maintenance Data Estimates) concerns resources applied to certain maintenance areas.

Please answer questions as specifically and frankly as possible. All answers will be kept confidential.

If any instructions or questions are unclear, call C. Harz or W. Whelan at the Rand Corporation, (213) 393-0411.

SECTION 1: MAINTENANCE BACKGROUND

INTRODUCTION/INSTRUCTIONS

This section requests a brief summary of your maintenance background and experience. Fill in the appropriate spaces in pencil or pen. Please begin.

1.1 What is your area of specialization?

70 ☐ Maintenance Assistance and Instruction Team (MAIT)

6 ☐ G-4

19 ☐ Other: _____

11 - Chief of DIO or Asst.
6 - DS/GS Auto Repair Sr. Spec./Technician
2 - CMD Logistics Asst.-Insp. Team

1.2 Under what command(s) are the units you are assigned to?

63 ☐ FORSCOM *23* ☐ USAREUR ☐ USASA *2* ☐ OTHER:

23 ☐ TRADOC ☐ USARJ ☐ EUSA _____

1.3 Which maintenance levels do you contact?

85 ☐ Organizational *69* ☐ Crew *70* ☐ DS *50* ☐ GS

1.4 Which types of divisional units do you contact?

43 ☐ Infantry *9* ☐ Airborne *7* - Other

46 ☐ Mechanized Infantry *36* ☐ Armored

1.5 How many years of experience do you have in Army vehicle maintenance?

Total Avg: 20.6 yrs

Military service: _____ Civilian service: _____

1.6 Which of the following have you worked at or served in prior to your present assignment?

35 ☐ CMMI Team *18* ☐ Depot

46 ☐ Vehicle Operator/Crew *68* ☐ DS/GS

69 ☐ Organizational Maintenance

1.7 Approximately how many vehicles are within the units you contact?

M113 series APC _____ M60 series tank _____ M151 series 1/4 T truck _____

M48 series tank _____ M35 series 2 1/2 T truck _____

SECTION TWO: MAINTENANCE PROBLEM AREAS

INTRODUCTION AND INSTRUCTIONS

This section contains questions designed to identify and describe problem areas and their impact. Answers are requested in the context of:

1. Your maintenance experience
2. Organizational and DS/GS units within your area of responsibility;
3. Four vehicle series: 1/4-ton trucks (M151); 2 1/2-ton trucks (M35); Armored Personnel Carriers (M113); and tanks (M48, M60).

Most questions have several parts, including an initial part requiring a Yes/No response. Check the appropriate box to indicate your answer. Additional information may be requested if indicated by arrows; namely: 1) the significance of the problem area stated in the questionaire; and 2) the impact or implications resulting from the question statement.

SIGNIFICANCE

The significance of a stated item--how important it is as a maintenance problem area--can be indicated by making a mark on a scale. The scale runs from 0 (indicating this area causes no maintenance problems) to 5 (indicating this area causes a large portion of maintenance problems). A mark of from 1 to 4 indicates a level of importance between these two extremes. If you felt, for instance, that there was high personnel turnover in Organizational and DS/GS units, and that this was a large contributing factor to maintenance problems, you might answer as follows to question 2.1.2:

2.1.2 Is there a high turnover of maintenance personnel?

EXAMPLE

☐ No
☒ Yes → Significance as a maintenance problem area (circle one)

unimportant 0 : 1 : 2 : 3 : (0) : 5 very important

A check in the "Yes" box requires a mark on the significance scale, as indicated by the arrow.

IMPACT

The impact of a stated item--what problems it leads to--is indicated by checking off THREE boxes under the descending arrow. If you choose "Other", write in the appropriate impact statement.

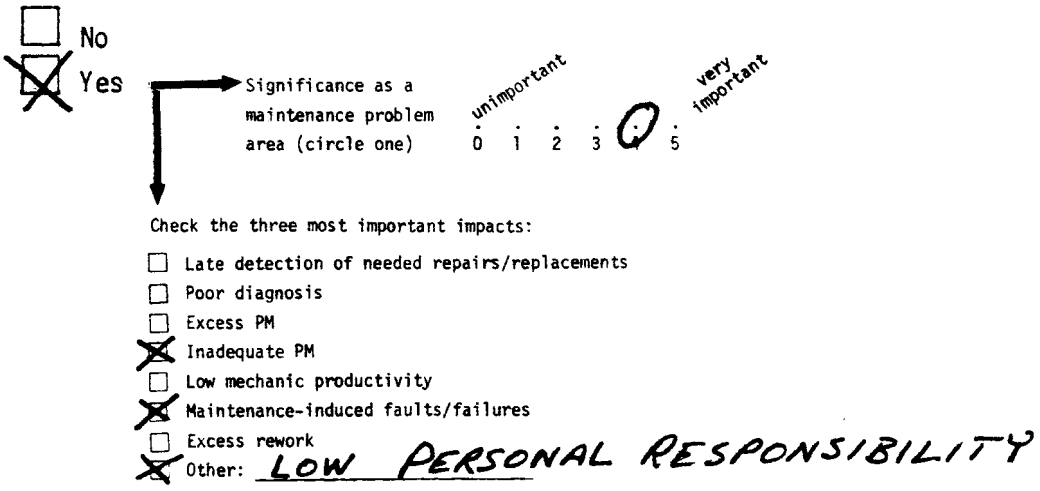
For instance, if you felt that the personnel turnover referred to in 2.1.2 resulted in

1. Inadequate periodic maintenance
2. Maintenance-induced faults/failures
3. Low personal responsibility,

you might indicate this as follows:

2.1.2 Is there a high turnover of maintenance personnel?

EXAMPLE

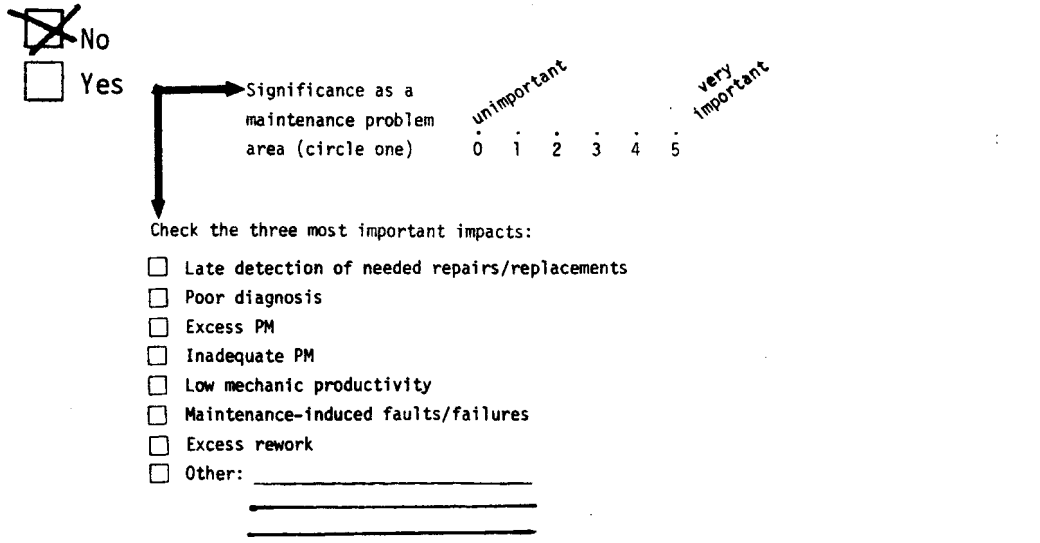


Check only impacts that you feel are a direct result of the question item.

If, on the other hand, you had felt there was no high turnover in Org. or DS/GS units, you would have marked the "No" box:

2.1.2 Is there a high turnover of maintenance personnel?

EXAMPLE



No response for significance or impact would have been necessary.

QUESTIONS WITH SECTIONS A, B, C...

Please respond to each section (A, B, C...) of every question. If you don't know the answer to what is being asked, write "DON'T KNOW," or put a question mark: "?". If what is asked does not apply to the units you contact, write "NOT APPLICABLE" or "N.A." If you don't understand the question, write this down under the comment section.

COMMENT

Please use the space provided under "COMMENT" to comment on the material covered by the question and to clarify your answer.

FILL-IN QUESTIONS

At the end of each section covering a general area (personnel, facilities, etc.) you will find a question that begins with "What other factors relating to...."; please fill in some questions that should have been asked, or issues that were not addressed.

2.1 PERSONNEL

2.1.1 A. Is there a shortage (MOS fill) of qualified* maintenance personnel?

☐ No
95% [X] Yes

Significance as a maintenance problem area (circle one) unimportant 0 1 2 3 4 5 very important AVG: 4.4

(NOTE: *The above score is the average of filled-in respondents' scores on the 0-5 scale.*)

Check the three most important impacts:

(NOTE: The most commonly checked boxes at right are marked by an "X")

- [X] Late detection of needed repairs/replacements
- [X] Poor diagnosis
- [ ] Excess PM
- [X] Inadequate PM
- [ ] Low mechanic productivity
- [ ] Maintenance-induced faults/failures
- [ ] Excess rework
- [ ] Other: *Poor OJT*
  Insuff. Man-Hr leads to paper maint.
  Long hours/too high workload
  Poor supervision, utilization

B. In which MOS categories is there a significant shortage or excess of qualified* personnel (mark "E" for excess, "S" for shortage):

	CATEGORY		LOCATION	
75 D	PLL Clerk	Org [S]	DS/GS	☐
45 N	Tank Turret Mechanic	☐		[S]
63 C	Motor Sergeants	[S]		☐
63 C	Tracked Vehicle Mechanics	[S]		[S]
63 B	Wheeled Vehicle Mechanics	[S]		[S]
63 A	Mechanic's Helpers	☐		☐
63 F	Recovery Specialists	☐		☐
71 T	Equipment Records Clerk	[S]		☐
63 G	Fuel & Electrical Systems Mechanics	☐		[S]
63 H	Automotive Repairman	☐		☐
Other:	*Fire Control Engr. Equipt.*	☐		☐
	Hydraulic Electronic			

C. Which shortage is most critical? *ORG: 71T/75D; 63C Motor Sgt.; 63B; 63C. DS/GS: 45N; 63C; 63B; 63G.*

*"Qualified" here refers to acceptability in terms of MOS standards (or Civil Service equivalents) and overall capability.

2.1.2 A. Is there a high turnover of maintenance personnel?

☐ No

89% ☒ Yes

Significance as a maintenance problem area (circle one) unimportant 0 1 2 3 4 5 very important AVG: 3.7

Check the three most important impacts:

- ☒ Late detection of needed repairs/replacements
- ☒ Poor diagnosis
- ☐ Excess PM
- ☐ Inadequate PM
- ☒ Low mechanic productivity
- ☐ Maintenance-induced faults/failures
- ☐ Excess rework
- ☐ Other: *Induces apparent shortage*
  Poor organization
  Low morale, responsibility
  No experience developed
  No time to develop sense of unit

Comment: *Causes attitude problem, e.g., "Don't care" attitude because (1) "I just got here"; or (2) "Can't get involved now - I'm leaving."*

Many PCS/ETS at same time.
Mechanics should have replacement personnel in unit before PCS/ETS.
Should eliminate "Up or Out" promotion policy and revise grade structure because:

- *Turnover not just due to ETS/PCS, but grade structure forces departure,*
- *Need more grade for professionals (or more pay scale) - like commercial shops,*
- *All ORG and DS/GS mechanics should be authorized to at least E5; this would allow training to be effectively utilized. Current system forces good mechanic out of skill before Army gets benefit from training.*

2.1.3 A. Do mechanics receive adequate MOS training in maintenance schools?

☐ Yes
72% ☒ No

Significance as a maintenance problem area (circle one) unimportant 0 1 2 3 4 5 very important AVG: 3.6

Check the three most important impacts:

- ☐ Late detection of needed repairs/replacements
- ☒ Poor diagnosis
- ☐ Excess PM
- ☐ Inadequate PM
- ☒ Low mechanic productivity
- ☒ Maintenance-induced faults/failures
- ☐ Excess rework
- ☐ Other: *High evacuation rate*
  Developing parts changers

B. If not, what shortcomings exist in training (specify MOS):

*Insufficient diagnosis and use of TMDE (esp. 63 MOS + Electric).**

Insufficient hands-on training and experience.

Need longer training, more basics.

Insufficient training in TMs and publications.

C. Do almost all mechanics attend basic maintenance school?

Yes - 63%

D. What percent of mechanics are not school trained in their MOS?

Average: approx. 30% (Range: 10-80%)

Comment: *Many assigned maint. MOS with no interest in it.*

Most mechanics complain of lack of hands-on training, esp. with TMDE.

Mechanics report schools should have more live instruction and hands-on, not students sitting in room looking at TV set or listening to tape.

MOS training not comprehensive, but units have no time for additional training.

*According to MAIT survey (at this base) most mechanics do not carry maintenance MOS, but are OJT.***

Need refresher training on new equipment.

In reserves, instructors are often unqualified (weekend soldiers).

**High similar-response rate.*

***Submitted from one USAR region only.*

2.1.4 A. Do mechanics receive <u>adequate</u> <u>OJT?</u>

☐ Yes

91% [X] No

Significance as a maintenance problem area (circle one) unimportant 0 1 2 3 4 5 very important AVG: 4.0

Check the three most important impacts:

- ☐ Late detection of needed repairs/replacements
- [X] Poor diagnosis
- ☐ Excess PM
- [X] Inadequate PM
- [X] Low mechanic productivity
- ☐ Maintenance-induced faults/failures
- ☐ Excess rework
- ☐ Other: _____

B. If not, how does OJT fall short? (Specify MOS)

*No structured program with planning, schedules, records exists.**

*Lack of qualified supervisors, sr. mechanics to conduct training.**

*Inadequate time allotted.**

Comment: *Normally no <u>real</u> program with objectives and tests. There <u>are</u> no supervised ORG. OJT programs. Units have no time, expertise to run OJT program. OJT personnel are sidetracked to unrelated tasks, esp. those not covered by TOE (details, cleaning, tool room man, TAMMs clerk, shop clerk, etc.).*

<u>Must</u> have <u>program</u> - only solution to problems.

DA should establish standards, elevate OJT to Installation level.

In USAR, OJT is a term, not a working program.

OJT seen as "cure-all" for untrained.

**High similar-response rate.*

2.1.5 A. What percent of total maintenance personnel is typically present for duty?

ORG: *60%* DS/GS: *70%*

B. What percent of the maintenance personnel present for duty actually perform maintenance or maintenance-related activities?

ORG: *60%* DS/GS: *60%*

C. What percent of the normal work day of maintenance personnel present for duty is usually spent in performing maintenance?

ORG: *50%* DS/GS: *60%*

Comment:
Maintenance personnel drawn into constant interruptions/unrelated tasks (guard duty, non-maint. training, post activities, etc.).
We expect 7 hr/day from civilians, 2 hr/day from MIL DS/GS.

2.1.6 A. Are there effective rewards for exceptional work and incentives to avoid mistakes?

☐ Yes

86% ☒ No

Significance as a maintenance problem area (circle one) unimportant 0 1 2 3 4 5 very important *AVG: 3.3*

Check the three most important impacts:

- ☒ Late detection of needed repairs/replacements
- ☐ Poor diagnosis
- ☐ Excess PM
- ☒ Inadequate PM
- ☒ Low mechanic productivity
- ☐ Maintenance-induced faults/failures
- ☐ Excess rework
- ☐ Other: *Lack of pride, interest, motivation*
  Low maintenance-related activity
  No advancement, self-improvement

B. Are existing incentive programs used?

No - 74%

C. Which existing incentive programs are effective and which ones are not effective? (Please specify why or why not).

Cash awards, Pro. pay good. No program exists. Sustained performance award effective in USAREUR -(used at GS only). Mech. Badge good but never given (except at departure).

Comment: *Driver's Badge, Mechanic's Badge should be implemented IAW AR 672-5-1; perhaps 10% of deserving mechanics get an award. Master Sgt. can't recognize mechanic - no mgt. techniques. Mechanics don't expect awards in an INF DIV because they're 2nd class citizens.*

2.1.7 A. Do mechanics and crews perform Periodic Maintenance (PM) in accordance with (IAW) stated Technical Manual (TM) schedules?

☐ Yes

93% [X] No

Significance as a maintenance problem area (circle one) unimportant 0 1 2 3 4 5 very important AVG: 4.4

Check the three most important impacts:

- [X] Late detection of needed repairs/replacements
- [X] Poor diagnosis
- [ ] Excess PM
- [X] Inadequate PM
- [ ] Low mechanic productivity
- [ ] Maintenance-induced faults/failures
- [ ] Excess rework
- [ ] Other: *Excess downtime; Minor failures leading to major ones; Unsafe equipment; More work at support level*

B. Which PM services are least likely to be performed and why? (Specify vehicle, if necessary).

Operator's PM. BDA Checks.* ORG PM (Q, S, A). LOs/Wheel Bearing pack. Those requiring TMDE. Those undetectable if left undone. Why: Lack supervision, time, motivation.*

C. Which PM services are least likely to be performed well and why? (Specify vehicle, if necessary)

Opr. PM. Opr. BDA.* ORG (Q, S, A).* All/General. ORG Q on tracks, Semi-annual on wheels. Battery svcs. LOs. Why: Lack supervision, enforcement, time, training.*

Comment: *Majority of faults should have been seen/corrected by operator. Poor enforcement of PM from Cdr. on down, and no follow-up. Often PM more damage than good, esp. wheel bearings, improperly torqued bolts and screws. Cdrs. show concern only when I.G. is due. PM program exists on paper only. Drivers/crews often return after duty hours to avoid post-op checks.*

**High similar-response rate.*

2.1.8 A. Do maintenance personnel generally attempt to go through troubleshooting steps in accordance with TMs?

☐ Yes

94% ☒ No

Significance as a maintenance problem area (circle one) unimportant 0 1 2 3 4 5 very important AVG: 4.3

Check the three most important impacts:

- ☒ Late detection of needed repairs/replacements
- ☒ Poor diagnosis
- ☐ Excess PM
- ☐ Inadequate PM
- ☐ Low mechanic productivity
- ☒ Maintenance-induced faults/failures
- ☒ Excess rework
- ☐ Other: *Don't learn from it Unnecessary parts repl.*

B. If not, why?

30%	☐ Lack of TMs	78%	☐ Insufficient Training
15%	☐ Lack of Serviceable TMDE	70%	☐ Poor Supervision
3%	☐ Other: *No cmd emph. Fear TMDE*	24%	☐ TMs Hard to Understand

Comment: *General feeling: It's faster to change parts than diagnose. Since supervisors untrained on TMs, don't enforce. Since troubleshooting not enforced, mechanics don't learn; this is the most difficult problem, and it's universal.*

2.1.9 If all mechanics were highly skilled and motivated, what would be the remaining major maintenance problems?

1) *Management, command emphasis*

2) *Supervision and scheduling*

3) *Operator abuse, failure to do PMCS*

2.1.10 A. What other factors relating to maintenance personnel contribute to maintenance problems? *Lack time; work interruptions. Supervisors not present, have low skills, poor attitude. Low command recognition, pride, job satisfaction.*

B. What impact does this have on maintenance? *Low productivity*

2.1.11 A. What is your overall assessment of maintenance personnel--how well they are trained, how well they use their time, etc.?

ORG: *Poor (poorly trained, utilized, supervised, motivated) (92%).*

DS/GS: *Poor (training, supervision, use of TMDE, utilization) (45%).*

B. What changes or trends in capabilities or performance of maintenance personnel have you noticed in recent years?

Poor/deteriorating - 88%

due to:

- *Motivation, pride*
- *Training (especially OJT and follow-on)*
- *Lack of command emphasis*
- *Greater sophistication of equipment*
- *Poor supervisor attitude, capability*
- *Trained personnel not stabilized on equipment (up or out promotion system)*
- *Less actual maintenance done, shortcuts and paper maintenance more acceptable*
- *Poor assignment of responsibility and follow-through*
- *Insufficient time allowed to maintain large number, mix of equipment*

Same - 8%

Improving - 4% due to:
- *command emphasis*
- *more time now being provided*

2.2 MAINTENANCE EQUIPMENT

Tools

2.2.1 A. Are authorizations for tools adequate?

68% [X] Yes

[ ] No → Significance as a maintenance problem area (circle one) unimportant 0 1 2 3 4 5 very important

Check the three most important impacts:

- [ ] Late detection of needed repairs/replacements
- [ ] Poor diagnosis
- [ ] Excess PM
- [ ] Inadequate PM
- [ ] Low mechanic productivity
- [ ] Maintenance-induced faults/failures
- [ ] Excess rework
- [ ] Other: _____

B. If tools are inadequate, which applies?

18% [ ] Different types of tools are needed. (Specify)
3/8 drive socket set. Special and laborsaving tools (impact wrenches, etc.). Larger variety hand tools. More modern.

12% [ ] More of the present tools should be authorized. (Specify)
Duplicates needed of common tools (often necessary to use more than one of same tool). Issue each mechanic his own tool set.

3% [ ] Other: *Better quality*

C. Are authorized tools almost always available to the mechanics or crews?
NO - 52%

D. If not, why? *Poor tool control (tools lost, tool room locked). Slow replacement of broken/missing.*

Comments: *Tool box should be given mechanic (esp. master mech.) when given MOS--make him responsible, possibly with a breakage allowance. Many mechanics "lose" tools till their home kits are full. Dock pay for lost tools.*
Tools often unavailable to operator for BDA.

Test, Measurement, and Diagnostic Equipment (TMDE)

2.2.2 A. Are authorizations for diagnostic equipment (TMDE) adequate?

74% [X] Yes

[ ] No → Significance as a maintenance problem area (circle one) unimportant 0 1 2 3 4 5 very important

Check the three most important impacts:

- [ ] Late detection of needed repairs/replacements
- [ ] Poor diagnosis
- [ ] Excess PM
- [ ] Inadequate PM
- [ ] Low mechanic productivity
- [ ] Maintenance-induced faults/failures
- [ ] Excess rework
- [ ] Other: _____

B. If TMDE authorization is inadequate, why?

15% [ ] Different types of TMDE are needed (specify): *Less bulky, simpler. Special test sets. Diff'l Tester for M151. Update/modernize. Small timing lights and VOMs.*

6% [ ] More of present TMDE should be authorized (specify): *Battery Tester. Vac. gauge and compr. gauge. TDA G.S. has no equipment for FCS.*

2% [ ] Other: *Give TMDE (compact) to mechanic as basic equipment.*

C. Is authorized TMDE almost always available to the mechanic? *Yes - 64%*

D. If not, why? *Calibration and repair. Access locked. "Use discouraged". Stored far away.*

Comment: *Most ORG shops use light bulb and 2 wires for electric testing. TMDE appears adequate, but since little used, can't tell. ORG's TMDE should be GO-NO GO type, DS's quantitative.*

Each master mechanic should have his own compact TMDE, esp. if assigned to maneuver unit.

Calibration of much of present TMDE time consuming.

Much not authorized, e.g., M60A1 has $1,000 generator, no test equipment authorized to test serviceability except multimeter.

2.2.3 A. Is available TMDE actually used?

☐ Yes

92% [X] No

Significance as a maintenance problem area (circle one) unimportant 0 1 2 3 4 5 very important AVG: 4.3

Check the three most important impacts:

- [X] Late detection of needed repairs/replacements
- [X] Poor diagnosis
- [ ] Excess PM
- [ ] Inadequate PM
- [X] Low mechanic productivity
- [ ] Maintenance-induced faults/failures
- [X] Excess rework
- [X] Other: *Guesswork and shortcuts*
  Prevents progress in new TMDE
  Don't learn from it
  Replacement of serviceable components

B. If available TMDE is not used, why?

- 85% ☐ Lack of training
- 35% ☐ Fear of damage to TMDE
- 8% ☐ Fear of personal hazard
- 23% ☐ Lack of TMs
- 44% ☐ Difficult to hook up and use
- 24% ☐ TMs hard to understand
- 20% ☐ Other: *Lack of trained supervision.* *Lack of confidence in ability of TMDE.* *Too lazy to use.*
- 22% ☐ TMDE not calibrated
- 30% ☐ Lack of critical items (batteries, connectors, etc.)
- 90% ☐ Diagnosis done by replacement
- 12% ☐ Too many individual items of TMDE required
- 2% ☐ TMDE not reliable

C. Is TMDE often not made available to mechanics because of inadequate safeguards against possible equipment theft or damage? (Explain)

NO - 73% *(Though sometimes overadequate safeguards, attitude of fear that damaged TMDE won't look good on inspection.)*

Comment: *Supervisors don't know how to use it, so "It's no good" (they discourage use).*

No knowledge of basic diagnostic concepts, thus TMDE useless.

Need refresher courses in units.

Tach-dwell retained due to fear of possible use on POV's.

2.2.4 What do you consider the most important problem relating to present TMDE?

*Lack of training, familiarity with importance of TMDE.**

Too cumbersome, long setup, complicated.

Not used. No supervision, comd. emphasis for use. Unavailable due to calibration, repair; difficult to maintain. Designed for use by dedicated technicians who appreciate gadgets and instrumentation.*

2.2.5 A. What other factors relating to tools and TMDE contribute to maintenance problems? *Equipment design -- too many tools needed. Lack tire breakdown tool. High tool ripoff rate. Lack of field maintenance shop sets and welding sets. Lack of trust in troubleshooting and TMDE.*

B. What impact does this have on maintenance? *Lack of tool to break tire beads leads to ruined tires. Tool theft, shortages leads to use of wrong tools, damaged equipment.*

2.2.6 What is your overall assessment of the tools and TMDE that maintenance personnel have to work with?

Tools: *Cheap quality, inadequate - 15%*
Adequate to good - 65%
Unavailable - 10%
Need better/more power, convenience tools - 10%

TMDE: *Too bulky, complicated, old - 40%*
Adequate to good - 45%
Unavailable/poor control - 5%
OK, but not used - 10%

COMMENT:

Calibration a problem; could use calibration/repair team to go to units.

Assign tools - now too much supervisor paperwork.

Need to convince mech. that TMDE is faster than "doing it by ear."

Gen. mech. tool box should keep up with civilian counterpart, e.g., needs to be on casters, not carried.

Mechanics can buy smaller, simpler equipment at local auto store.

**High similar-response rate.*

2.3 FACILITIES

2.3.1 A. Are shop facilities adequate for proper support of vehicle maintenance?

☐ Yes

74% ☒ No

Significance as a maintenance problem area (circle one) unimportant 0 1 2 3 4 5 very important *AVG: 4.0*

Check the three most important impacts:

- ☒ Late detection of needed repairs/replacements
- ☐ Poor diagnosis
- ☐ Excess PM
- ☒ Inadequate PM
- ☒ Low mechanic productivity
- ☐ Maintenance-induced faults/failures
- ☐ Excess rework
- ☐ Other: *Facilities overcrowded*
  Poor safety rate

B. If not adequate, why?

- *65%* ☐ Space limitation
- *62%* ☐ Poor heating or ventilation
- *28%* ☐ Lack of hard stands
- *55%* ☐ Improper lighting
- *36%* ☐ Grease pits or racks unavailable
- *15%* ☐ Other: *Electric wiring, outlets*

Poor design. Shared facilities. Latrines. No tire, battery, welding areas.

C. Are proper storage facilities provided for parts?

NO - 51%

D. Are storage facilities used properly? *YES - 53% (when they exist)*

NO - 47% (lack space, security, much outdoors)

Comment: *Need oil/grease disposal.*
No battery chg. shop, no lube reels, no waste provisions.
TK. BN here has 3 shops unable to hold a tank.
Many old buildings (WW II and before).

2.3.2 A. What other factors relating to facilities contribute to maintenance problems?

Poor layout, design (little user feedback).

No shop office. No latrines, drinking fountains. Designed for different equipment mix than now exists.

B. What impact does this have on maintenance?

Low productivity. Low morale.

2.3.3 What is your overall assessment of maintenance facilities?

at ORG: *Poor to fair - 35%. Adequate - 45%. Varies strongly unit to unit - 20%.*

at DS/GS: *Poor to fair - 50%. Adequate - 34%. Good (esp. G.S.)- 16%.*

COMMENT:

DS needs more laborsaving devices (cranes, lube stations, etc.).
Facilities are big morale factor.
A cold mechanic is a nonproductive mechanic.
People in a shade tree environment do shade tree workmanship.

2.4 VEHICLES

2.4.1 A. Are new or overhauled/rebuilt vehicles almost always received by the unit in good condition?

72% [X] Yes

[ ] No → Significance as a maintenance problem area (circle one) unimportant 0 1 2 3 4 5 very important

Check the three most important impacts:

- [ ] Late detection of needed repairs/replacements
- [ ] Poor diagnosis
- [ ] Excess PM
- [ ] Inadequate PM
- [ ] Low mechanic productivity
- [ ] Maintenance-induced faults/failures
- [ ] Excess rework
- [ ] Other: _____

B. In what vehicle subsystems is poor manufacture, overhaul, or rebuild evident? (Specify) *Overhauled engines (esp. M113, M60). M113 transfer, transmission. Comb. veh. hydraulics. Electrical M35s rebuilt in Taiwan. Carbs.*

C. Are vehicles damaged seriously in transit? (Explain)
NO - 87%
YES/sometimes - 13% (Pilferage, vandalism, damaged batteries and starters)

D. Are vehicles prepared properly for issue? (Explain)
YES - 77% (this is lg. workload, not properly recognized)
NO - 13% (some units required to "in process" equipment to get quick delivery)

E. How reliable are overhauled/rebuilt vehicles compared to new vehicles?
Same/good - 65%
Not as good - 35% (may depend on depot, world location)

Comment: *Improvements in QC/QA last 3-5 years.*
Need more emphasis on initial, final inspection.
Overhauled OK except those done under IROAN - need more maint. to keep running.
New equipment has faults which take time to detect.
Army thinks vehicles OK if ORG/DS doesn't write EIRs.

2.4.2 A. Do vehicles coming from extended storage have more maintenance problems than vehicles from production or overhaul/rebuild?

☐ No

74% ☒ Yes → Significance as a maintenance problem area (circle one) unimportant 0 1 2 3 4 5 very important AVG: 3.5

Check the three most important impacts:

- ☐ Late detection of needed repairs/replacements
- ☐ Poor diagnosis
- ☐ Excess PM
- ☐ Inadequate PM
- ☐ Low mechanic productivity
- ☐ Maintenance-induced faults/failures
- ☒ Excess rework
- ☐ Other: *Missing parts*
  Deterioration - seals, belts, hoses, etc.
  Much time replacing seals and PFO work

B. If so, why? *Deterioration.* (rust, seals, gaskets, dry rot, dry wiring harnesses, rubber, dry bearings, belts, dirty air and brake lines, etc.). In-storage inspection and maintenance not enforced, done.**

C. Are stored vehicles properly prepared for issue? (Explain)
No - 58% (deteriorated items not replaced, insuff. time allowed for preparation, some cold issue, i.e., as is).

Comment: *Many seals and gaskets look serviceable until use.*
Vehicles from controlled humidity warehouses usually OK.
War Reserve Stock (USAREUR) should be rotated or used.
Extended storage in rough outdoors leads to long prep., high costs.
This DIV recently received vehicles where preservative in fuel tanks not removed.
Metal surfaces above lube level rust; condensation causes damage in brake systems, valve train problems.
Even if properly prepared, many faults not detected until vehicle put in operation (3000-5000 miles for trucks).
Deterioration includes: brake cylinders seized, wheel bearings rusted, canvas torn, condensation in gear case (problem after use).

* *High rate of similar response.*

2.4.3 A. What other maintenance problems "come with the vehicles" upon delivery to the units? *Incomplete historical documents (logbooks, etc).*
Some faults take a while to surface.
Missing parts (batteries, turn signals, lights).
Vehicles issued w/o pubs

B. Are unsatisfactory equipment reports almost always properly filled out on defective parts of new vehicles? *NO - 68%*

Comment: *Easier to replace part than fill out EIR-report no obvious benefit to unit.*
Units fix vehicles, skip paperwork.

2.4.4 A. Are some vehicles in a unit used with much greater frequency than others (of the same type)?

☐ No ☒ Yes *89%* Why? *Assignment/Mission - some sections (e.g., mail, mess) use more than others.**
Newer vehicles used; "dogs" left in motor pool.

B. Should more effort be made to rotate use of vehicles? (Explain)
YES - 76% (consolidate usage, rotate by mileage).
NO - 24% (will cause less opr. responsibility if no assigned operators).
Note that many vehicles are difficult to reconfigure (truck beds).

2.4.5 What subsystems or items cause the most unscheduled maintenance?

M 151: *Diff'l/U-joints/Prop shaft.** *Clutch.* *Elec/distrib/ignition.*
Fuel system.

M 35: *Fuel system.* *hydrovac/brakes.* *Clutch.*
Elec/distrib/ignition/batt

M113: *Eng.* *Elec/ignition/batt.* *Communications equipment.*
Fuel system. *Sprockets/track/susp.*

M48/60: *Pack.* *Elec/batt/starter.* *Communications equipment*
Track/roadwheels/susp. *Turret/FSC.*

2.4.6 A. What other factors relating to vehicle design, production, overhaul/rebuild or storage contribute to serious maintenance problems?
Poor maintainability, poor access
Vehicles designed for qualified technician, not actual skill level.
Continued modifications. Poor wiring harnesses on combat vehicles.

B. What impact does this have on maintenance?
As sophistication goes up, maintenance requirements go up.
Difficult access (filters, lube pts, fuel cells, etc) leads to excess time, PM not done, parts broken/dropped; faulty wiring leads to many fires.

*High similar response.

2.5 VEHICLE USERS (DRIVERS AND CREWS)

2.5.1 A. Do drivers almost always operate vehicles properly?

☐ Yes

95% ☒ No

Significance as a maintenance problem area (circle one) unimportant 0 1 2 3 4 5 very important

Check the three most important impacts:

- ☒ Late detection of needed repairs/replacements
- ☐ Poor diagnosis
- ☐ Excess PM
- ☒ Inadequate PM
- ☐ Low mechanic productivity
- ☐ Maintenance-induced faults/failures
- ☐ Excess rework
- ☐ Other: *Damage/Abuse*
  Excess breakdown
  Shortened vehicle life
  Poor economy

B. If not, what types of improper operation occur?

70% ☐	Revving too high (overspeed)	80% ☐	Popping clutch
60% ☐	Revving too low (lugging)	80% ☐	Riding clutch
55% ☐	Driving too fast on-road	45% ☐	Overheating engine
60% ☐	Driving too fast off-road	60% ☐	Operating with low fluid levels

30% ☐ Other: *Hot/Fast diesel shutdown. Improper warmup. Improper shift/start in 2nd or 3rd gear. No BDA checks. Undrained filters and air tanks.*

C. To what extent and how often does this occur? (Specify)

Seldom - 1%. Daily/often/common - 99% (especially new or young operators; esp. bad during FTX or AT; continuous hot rodding)

Comment: *Poor supervision, dispatching.*
Poor driver training, testing.
Most important contributor to maint. problems.
Many premature eng., T/M and clutch failures.
At least 60% of component replacement is due to improper operation or lack of crew/opr. maint.
Units have few assigned/dedicated drivers; driving is additional duty.
3 out of 4 new vehicles coming in to DS/GS are there for burned out clutches, overheated engines, ruined transmissions, etc.

2.5.2 A. Do operators almost always perform pre-op and post-op checks in accordance with TMs?

☐ Yes

99% [X] No

Significance as a maintenance problem area (circle one) unimportant 0 1 2 3 4 5 very important AVG: 4.6

Check the three most important impacts:

- [X] Late detection of needed repairs/replacements
- [X] Poor diagnosis
- [ ] Excess PM
- [X] Inadequate PM
- [ ] Low mechanic productivity
- [ ] Maintenance-induced faults/failures
- [X] Excess rework
- [ ] Other: *Accidents*
  Excess D/T
  Minor become major faults
  Shortens equipt. life

B. If not, why? *No cmd. emphasis. Poor supervision.* Poor training. Lack incentive/motivation/responsibility.**

Comment: *No disciplinary actions taken for nonperformance.*
Should reduce PMCS but enforce.
Many units no assigned drivers, no emphasis on responsibility.
Maintenance must begin with operator.
Leaders not trained--don't understand importance
Probably most important failure in maintenance system
DIO has noted high consumption rate due to "dirt damaged" assemblies.
Operator returns after duty hours to avoid post op checks.
Used to private cars--they drive, others maintain.

**High similar-response rate.*

2.5.3 A. Do operators receive adequate training in vehicle operation?

☐ Yes

90% ☒ No

Significance as a maintenance problem area (circle one) unimportant 0 1 2 3 4 5 very important AVG: 4.6

Check the three most important impacts:

- ☒ Late detection of needed repairs/replacements
- ☐ Poor diagnosis
- ☐ Excess PM
- ☒ Inadequate PM
- ☐ Low mechanic productivity
- ☐ Maintenance-induced faults/failures
- ☐ Excess rework
- ☐ Other: *Vehicle abuse*; *Excess D/T*

B. If not, what areas are they lacking in? *Basic/General.**

BDA. Use of TMs/Pubs. Clutch, gears.

Comment: *No real driver training program, just lip service.**

Every unit should have 4-8 hr/wk for training; FM 29-2 suggests it, but is ignored.

No professionals due to Up or Out promotion.

Driver training is a farce or not conducted at all.

**High similar-response rate.*

2.5.4 A. Do operators receive adequate training in vehicle maintenance?

☐ Yes

91% ☒ No → Significance as a maintenance problem area (circle one) unimportant 0 1 2 3 4 5 very important AVG: 4.6

Check the three most important impacts:

- ☒ Late detection of needed repairs/replacements
- ☒ Poor diagnosis
- ☐ Excess PM
- ☒ Inadequate PM
- ☐ Low mechanic productivity
- ☐ Maintenance-induced faults/failures
- ☐ Excess rework
- ☐ Other: *No opr. responsibility*
  Opr.-induced faults
  Excess D/T

B. If not, what areas are they lacking in?

62% ☐ Basic vehicle operation
92% ☐ Performing -10 series maintenance
75% ☐ Inspection requirements
30% ☐ Other: *Knowledge of Operator's Manual, TM. Detection of possible problems.*

C. Do operators almost always report potential trouble to mechanics? (Explain)
NO - 88% (because they can't see them/they don't want to see them--may mean work).

D. Do operators describe problems to mechanics adequately? (Explain)
NO - 90% (don't key fault to TM checklist, don't take time, don't fill out 2404).

Comment: *By time they learn they are promoted to another job. Often no assigned vehicle--thus wait and hope it breaks on the next guy. Personnel at units we (MAIT) asked were not trained or tested on their equipment, or in filling out forms. Operators need refresher training at unit or post level.*

2.5.5 A. What other factors relating to operators contribute to maintenance problems? *No assigned operators. Poor attitude/motivation. Poorly trained, motivated leaders. Operator doesn't gain if equipment operates--often exactly the opposite.*

B. What impact does this have on maintenance? *Attitude: "Let the next guy do it." Fact that operator doesn't gain from operational vehicle leads to intentional destruction to avoid work or field duty.*

2.5.6 What is your overall assessment of operators and crews with regard to vehicle operation and maintenance?

Poorly trained, tested.

Poorly supervised.

Operators reflect poor commander and supervisor attitudes.

Driver and maintenance training should be elevated to the level of other training.

Should have dedicated/specialized drivers, not promote good ones out of the job.

Operators need training--should have practical experience with trailers and in mud and snow.

2.6 REPAIR PARTS AND POL

2.6.1 A. Are essential vehicle repair parts usually <u>available</u> within a few days?

☐ Yes

51% ☒ No

Significance as a maintenance problem area (circle one) unimportant 0 1 2 3 4 5 very important AVG: 4.4

Check the three most important impacts:

- ☐ Late detection of needed repairs/replacements
- ☐ Poor diagnosis
- ☐ Excess PM
- ☒ Inadequate PM
- ☒ Low mechanic productivity
- ☐ Maintenance-induced faults/failures
- ☐ Excess rework
- ☒ Other: *Excess NORS*; *Ordering excess parts*; *Cannibalization*; *Backlog*

B. If not, why? *System difficult given personnel skill and experience.*

C. Do mechanics and supply clerks almost always know how to order parts? (Explain) *YES - 59% (however, often don't edit/follow-up).*

NO - 41% (insufficient training on parts manual; lack P series TMs).

D. How often are repair parts procured outside Army supply channels?

Not often - 75%

E. Are repair parts often in stock locally, but not obtainable because they cannot be located? (Explain) *YES - 21% (changes in NSNs, poor warehouse procedures); SELDOM - 79%*

Comment: *Within a <u>few</u> days? <u>One</u> day too slow for essential items!*

System lacks follow-up.

Tank and machine gun parts critical.

Hard to procure due to multitude of equipment types.

System OK <u>if</u> used right .

Clerks need AR 710-2 training.

2.6.2 A. Are new or rebuilt parts/components often substandard?

68% [X] No

[ ] Yes → Significance as a maintenance problem area (circle one) unimportant 0 1 2 3 4 5 very important

Check the three most important impacts:

- [ ] Late detection of needed repairs/replacements
- [ ] Poor diagnosis
- [ ] Excess PM
- [ ] Inadequate PM
- [ ] Low mechanic productivity
- [ ] Maintenance-induced faults/failures
- [ ] Excess rework
- [ ] Other: _____

B. If so, how or why? (Specify new/rebuilt) *Electric rebuilt. Many problems with rebuilt M35 air hydraulic cylinders. DX'd items (gen's, starters). Tank final drives from Taiwan steel.*

Comment: *Rebuilt engines not given enough run-in; cracked blocks. Depends on area of world unit is in. Especially rebuilt items that can't be tested, e.g., diff'l of M151.*

2.6.3 For which types of essential parts do mechanics wait the longest?

	Part Description	How Long	Why
1.	*Engines*	*1-12 mos*	*Slow rebuild; not stocked locally*
2.	*Batteries*	*1-4 mos*	*Procurement lag*
3.	*Reg/gen/starter*	*3-8 wks*	*High usage*
4.	*Gaskets, seals*	*3-6 wks*	*Inadequate stocking*
5.	*Air cleaners, elements*	*2-24 wks*	*Inadequate stocking*

Comment: *Delays on many fringe/low usage or high dollar items. Often happens if any change in system: new FSN, funding, supply source, unit of issue, etc. Response varies from GSA (poor) to TARCOM (best).*

2.6.4 A. Are petroleum, oil, or lubricants often substandard or contaminated?

85% [X] No

[ ] Yes → Significance as a maintenance problem area (circle one) unimportant 0 1 2 3 4 5 very important

Check the three most important impacts:

- [ ] Late detection of needed repairs/replacements
- [ ] Poor diagnosis
- [ ] Excess PM
- [ ] Inadequate PM
- [ ] Low mechanic productivity
- [ ] Maintenance-induced faults/failures
- [ ] Excess rework
- [ ] Other: _____

B. If so, how or why? (Specify type of POL) *Water in MOGAS. GAA - noticeable separation. Low octane gas, Poor DS2.*

C. Where in the storage/delivery process does contamination occur, if any? *Within unit motor pools/POL shelters.*

Comment: *Motor pool lacks storage for oil drums - left uncovered, in open air. Problems with DS2 heating oil in cold. Units use #2 diesel in subzero (it gels).*

2.6.5 A. What other factors relating to parts and POL contribute to maintenance problems? *FORSCOM extended maint. program confusing. Delays in PLL clerk ordering. Low PLL stockage. Constant changing of FSCs and subbing of NSNs.*

B. What impact does this have on maintenance? *Parts delays lead to NORS, backlog, negates PM. Contaminated oil and grease leads to the failure of internal parts.*

Comment: *Should use synthetic oil--superior in tests. Historical data uncaptured results in slow parts sys. Oil analysis program very beneficial--should be expanded.*

2.6.6 What is your <u>overall assessment</u> of repair parts and POL as they affect the maintenance effort? *Parts system poor/slow. Parts system adequate. Shortage of parts causes much controlled subst. Parts system OK if enforced. Not the problem--many parts are replaced, should be fixed/adjusted. Little parts cause more problems than large assy's.*

2.7 MAINTENANCE DOCUMENTATION AND FORMS

2.7.1 A. Is maintenance documentation (TMs, pamphlets, manufacturer's publication, wall charts, etc.) almost always available?

☐ Yes

63% ☒ No

Significance as a maintenance problem area (circle one) unimportant 0 1 2 3 4 5 very important *AVG: 4.3*

Check the three most important impacts:

- ☒ Late detection of needed repairs/replacements
- ☒ Poor diagnosis
- ☐ Excess PM
- ☒ Inadequate PM
- ☒ Low mechanic productivity
- ☐ Maintenance-induced faults/failures
- ☐ Excess rework
- ☐ Other: _____

B. What documentation, if any, is often unavailable? *Current TMs. Current Operator's Manuals. LOs. Parts manuals.*

C. If unavailable, why?

30% ☐ Units have not established publication pinpoint accounts

50% ☐ Clerks unfamiliar with ordering procedures

25% ☐ Other: *Distribution within BN poor. No assigned pers. responsibility for tech libraries/no follow-up.*

D. Is available documentation usually used or referred to for maintenance by mechanics? *NO - 67%*

E. If not, why? *Difficult to read. No supervision, cmd. emphasis. Supervisors don't require use. Mechanics seem to think they don't need to use them.*

Comment: *Need cmd. emphasis on availability and use of TMs; mandatory use of TMs and procedural checks used as with aircraft. Pinpoint acct. should be with specific unit--pubs sent to BN are lost before reaching specific facility.*

2.7.2 A. Is there adequate <u>feedback</u> of maintenance experience from the <u>units</u> to the <u>originators</u> of maintenance publications?

☐ Yes

78% ☒ No

Significance as a maintenance problem area (circle one) unimportant 0 1 2 3 4 5 very important *AVG: 3.3*

Check the three most important impacts:

- ☒ Late detection of needed repairs/replacements
- ☐ Poor diagnosis
- ☐ Excess PM
- ☒ Inadequate PM
- ☐ Low mechanic productivity
- ☐ Maintenance-induced faults/failures
- ☐ Excess rework
- ☒ Other: *None of the above*

B. If not, why? *Originators don't visit field enough. No motivation. encouragement. Mechanics poor writers, afraid of paperwork.*

Comment: *Writers and PLL managers need to set up team to contact personnel, supervisors, field and tech. reps, and should then broadcast problems Put preprinted form in each TM/TB.*

Slow/poor return on submissions.

Units fear pencils.

2.7.3 A. Are TMs useful aids for orderly, step-by-step troubleshooting?

86% [X] Yes

[ ] No → Significance as a maintenance problem area (circle one) unimportant 0 1 2 3 4 5 very important

Check the three most important impacts:

- [ ] Late detection of needed repairs/replacements
- [ ] Poor diagnosis
- [ ] Excess PM
- [ ] Inadequate PM
- [ ] Low mechanic productivity
- [ ] Maintenance-induced faults/failures
- [ ] Excess rework
- [ ] Other: _____

B. If not, why? *Complicated for average mechanic. Poor troubleshooting guides--lead in circles.*

C. Are TMs understandable to mechanics? (Explain) *YES - 51%*
Note: newer ones are much better.

Comment: *Simplify troubleshooting charts for tanks.*
Mechanics must be forced to read by supervisor.
Schematics poor.
Too many "refer-to's," skipping page to page (e.g., for M60A1).
TMs no help to inexperienced mechanics.

2.7.4 A. Are present maintenance forms appropriate for their intended purposes?

83% [X] Yes

[ ] No → Significance as a maintenance problem area (circle one) unimportant 0 1 2 3 4 5 very important

Check the three most important impacts:

- [ ] Late detection of needed repairs/replacements
- [ ] Poor diagnosis
- [ ] Excess PM
- [ ] Inadequate PM
- [ ] Low mechanic productivity
- [ ] Maintenance-induced faults/failures
- [ ] Excess rework
- [ ] Other: _____

B. Which present forms should be revised/eliminated? _____

Comments: *Data is of poor utility to units, high burden.*

Need system of stickers like civilian service station.

Prepare log book with all PMCS (like civilian car)--tear out portions as performed, forward to central authority.

Maintenance forms OK, data useless.

Best forms in 15 years (of 9 different systems).

Should implement credit card system for transfer of data to DA forms (like civilian service station).

Need checklist for PMCS.

TAMMS repetitive and serves no purpose. No follow-up if;forms not submitted (e.g., DA2408-4)no one cares.

Data not being used at any level below DIV.

2.7.5 A. Are present maintenance forms almost always filled out correctly?

☐ Yes

94% ☒ No

Significance as a maintenance problem area (circle one) unimportant 0 1 2 3 4 5 very important AVG: 3.9

Check the three most important impacts:

- ☒ Late detection of needed repairs/replacements
- ☐ Poor diagnosis
- ☐ Excess PM
- ☒ Inadequate PM
- ☐ Low mechanic productivity
- ☐ Maintenance-induced faults/failures
- ☐ Excess rework
- ☐ Other: *Low evolution in maint. mgt.*

B. Which forms, if any, are often intentionally falsified?

- 50% ☐ 2404
- 88% ☐ 314 Preventative Maintenance Schedule and Record
- 15% ☐ Other: *DA2404 ESC, DA2408 (-9,-4,-5)*
- 42% ☐ 2408-1
- 70% ☐ 2406
- 10% ☐ 2407 Maintenance Job Request
- 45% ☐ 2408-14

C. Which forms, if any, are often not filled out at all?

- 75% ☐ 2404
- 1% ☐ 2406
- 25% ☐ 2408-1
- 38% ☐ 2408-14
- 25% ☐ Other: *2404 ESC. 314. 2408(-5,-7,-8,-1 daily, -9,-4,-10). 2400 Dispatch.*

Comment: *Forms generally brought up to date just before inspection. No supervisory follow-up, checks. Personnel take vehicles out without dispatch (Form 2400) in most cases; even use D/L vehicles. Units fall behind on services so they pull pencil type services. Cmdrs. fear bad OER if OR not up. Forms are falsified to pass inspection by MET or AGI. Supervisor does most of falsification to cover for inspection, then it becomes a habit.*

2.7.6 A. Do readiness reports (MRR, ESC, 2406, 2715)give an accurate picture of the availability of a vehicle fleet? (Explain) *NO - 92%*

Cmdrs fear bad OER;figures show what cdr wants.

Comment: *Units give inflated, false reports. Obvious coverup/borders on blatant. Manipulation of "as of" data allows "projection", theoretical cross-leveling of faulty components - false sense of security.*

2.7.7 Are present maintenance records consolidated to give an accurate maintenance history of a vehicle fleet to the unit commander? (Explain) *NO - 83%*

Garbage in/garbage out (basic data poor).

Would be OK if they were accurate.

2.7.8 A. What other factors relating to maintenance documentation and forms contribute to maintenance problems? *Documentation time consuming.*

Requires lg. effort in training, supervision (clerks inadequately trained).

Complicated by local directives - local policies make data comparisons difficult.

B. What impact does this have on maintenance?

Operation of equipment in RED status causes major repair.

Falsified records cause untimely maintenance.

Paperwork robs time (esp. for supervisors).

2.7.9 What is your overall assessment of maintenance documentation and forms -- availability, relevancy, support of maintenance operations, etc.?

System OK but not followed.

Needs reduction, consolidation of paperwork.

Poor to fair. Adequate.

Varies with cmd. emphasis.

OR is false --- due to:
- *local falsification/omission*
- *theoretical "Projections"*
- *poor inspection capability*
- *changes to data by cdr., higher HQ.*

2.8 MAINTENANCE ORGANIZATION, POLICY AND PROCEDURES

2.8.1 A. Are present Periodic Maintenance (PM) schedules for vehicles adequate?

75% [X] Yes

[ ] No → Significance as a maintenance problem area (circle one) unimportant 0 1 2 3 4 5 very important

Check the three most important impacts:

- [ ] Late detection of needed repairs/replacements
- [ ] Poor diagnosis
- [ ] Excess PM
- [ ] Inadequate PM
- [ ] Low mechanic productivity
- [ ] Maintenance-induced faults/failures
- [ ] Excess rework
- [ ] Other: _____

B. Where should authorized PM be reduced? (Specify vehicle) _____

None in Active Army. Many in USAR.

Reduce M35 and M151 if assigned drivers. Lube gear case only if contaminated. Extend oil and filter if no mileage.

C. Where should authorized PM be increased? (Specify vehicle) _____

None. Do road marches, not motor pool warmup. All, if no assigned drivers. All long term storage.

Comment: *Should be demand-based, not time--why perform 3,6,9,12-month PM on equipment driven 50-100 miles. Standardize PM/LO intervals for all tracks, wheels. Base PM more on actual usage, especially in USAR.*

2.8.2 A. Is there a common practice of repair by replacement (that is, replacing parts by trial and error instead of troubleshooting)?

☐ No

96% [X] Yes → Significance as a maintenance problem area (circle one) unimportant 0 1 2 3 4 5 very important AVG: 4.0

Check the three most important impacts:

- ☐ Late detection of needed repairs/replacements
- [X] Poor diagnosis
- ☐ Excess PM
- ☐ Inadequate PM
- [X] Low mechanic productivity
- ☐ Maintenance-induced faults/failures
- [X] Excess rework
- ☐ Other: *Excess D/T*
  Excess parts cost

B. How prevalent is this? *Often/common - 99%*

C. For which vehicle parts or subsystems is this most common?

90% ☐ Generator *70%* ☐ Starter *92%* ☐ Voltage Regulator
75% ☐ Carburator *30%* ☐ Fuel Injector Pump
28% ☐ Other: *M35 air hydraulic cylinder.*
Electrical (spark plugs, ign. coil, alternator, etc.).
Batteries.

D. Under what conditions (if any) could trial-and-error replacement be the best way to make a repair? *None unless TMDE unavailable or if cost or time negligible (e.g., light bulbs, tubes, plug-in modules).*

Comment:

Trial and error is the common practice.

Fuel and electrical repair mechanics the worst.

Batteries get replaced in sets (not tested with load bank).

Must be controlled by supervisor--require proof of failure with TMDE.

Original part seldom reinstalled.

At Ft. Carson, 4 tank engines were to be replaced in one BN; when competent personnel checked prior to removal--only one replacement, 3 others fixed on site the same day.

2.8.3 A. Is there an unofficial policy/practice to "drive it until it breaks" (as opposed to replacing vital parts that can still function but are starting to fail)?

53% [X] No

[ ] Yes → Significance as a maintenance problem area (circle one) unimportant 0 1 2 3 4 5 very important

Check the three most important impacts:

- [ ] Late detection of needed repairs/replacements
- [ ] Poor diagnosis
- [ ] Excess PM
- [ ] Inadequate PM
- [ ] Low mechanic productivity
- [ ] Maintenance-induced faults/failures
- [ ] Excess rework
- [ ] Other: _____

B. How prevalent is this? *This is IROAN stated policy.*

Comment: *If it doesn't cause future damage it shouldn't be replaced. Lack of COLEX funds leads to running vehicles to end. Cdrs. don't see that early maintenance will increase OR. Minor go to major repairs. Illusion of "most for the dollar."*

2.8.4 What major problems are associated with repairing vehicle breakdowns in the field?

1. *Lack parts, tools and TMDE.*
2. *Weather/environment (terrain, dirt, cold, no tent or shelter).*
3. *Lack facilities (lift, light, power tools, hard stands, power for TMDE). Poor planning, mgt. Lack practice training.*

2.8.5 What is your overall assessment of maintenance organization, policies, and procedures? *Official policy usually different from real-life situation*

2.9 MAINTENANCE MANAGEMENT

2.9.1 A. Is there sufficient command interest in and emphasis on maintenance?

☐ Yes

86% ☒ No

Significance as a maintenance problem area (circle one) unimportant 0 1 2 3 4 5 very important *AVG: 4.1*

Check the three most important impacts:

- ☒ Late detection of needed repairs/replacements
- ☐ Poor diagnosis
- ☐ Excess PM
- ☒ Inadequate PM
- ☒ Low mechanic productivity
- ☐ Maintenance-induced faults/failures
- ☐ Excess rework
- ☐ Other: _____

B. Is command interest usually evident (by commander's presence, etc.)?

NO - 86%

Neither senior nor junior officers--seldom seen in shop.

Not at CO level--Cdr doesn't know what to look for.

C. How does command interest usually influence the maintenance effort?

Critical influence ("makes it or breaks it"). If Cdr is interested others are interested, and maintenance improves immediately.

Comment: *Those things get done that the boss checks.*

Cdrs are unaware of shape of equipment or time required for maint.

Cdrs exert pressure by letters, but don't follow up.

Some Cdrs want to get involved, but don't know how.

Many Cdrs have no mechanical training.

2.9.2 A. Do the units almost always have a maintenance standing operating procedure (SOP)?

82% [X] Yes

[ ] No

Significance as a maintenance problem area (circle one) unimportant 0 1 2 3 4 5 very important

Check the three most important impacts:

- [ ] Late detection of needed repairs/replacements
- [ ] Poor diagnosis
- [ ] Excess PM
- [ ] Inadequate PM
- [ ] Low mechanic productivity
- [ ] Maintenance-induced faults/failures
- [ ] Excess rework
- [ ] Other: _____

B. Is the SOP, if any, disseminated and posted? (Explain)

NO - 63% (kept on file only)

C. Is the SOP followed? (Explain)

NO - 88% (only for inspection purposes, often meaningless)

D. Is the SOP often outdated? *YES - 82%*

Comment: *Must simplify and make meaningful.*

SOPs kept as eyewash, for inspections only.

Not updated after change of command--often undated and unsigned.

Very important--should show Cdr's policy, outline procedures and responsibility.

Currently have management by exception, personnel confusion.

2.9.3 A. Are Periodic Maintenance periods almost always supervised?

☐ Yes

87% ☒ No → Significance as a maintenance problem area (circle one) unimportant 0 1 2 3 4 5 very important AVG: 4.6

Check the three most important impacts:

- ☒ Late detection of needed repairs/replacements
- ☒ Poor diagnosis
- ☐ Excess PM
- ☒ Inadequate PM
- ☒ Low mechanic productivity
- ☐ Maintenance-induced faults/failures
- ☐ Excess rework
- ☐ Other: *Operator apathy*

Poor opr. maint., wrong procedures

Excess D/L

B. If not, why? *Supervisors do paperwork, other duties, not motor pool.**

*Lack of cmd. interest, emphasis.**

Supervisors untrained. PM periods erratic. Attitude/motivation of supervisors poor.**

Comment: *PM periods frequently not on unit training schedule.*

Many Cdrs. use this period to hold other meetings.

Supervisors and Cdrs. feel they have more important things to do.

2.9.4 A. Please rank the following areas in the order that they contribute to maintenance problems (1 = contributes the most, 11 = contributes the least).

3	Personnel Shortages and Turnover	*10*	Vehicle Storage
2	Personnel Training and Motivation	*5*	Supplies (parts and POL)
6	Tools	*9*	Documentation and Forms
7	Facilities	*4*	Organization, Policy and Procedures
11	Vehicle Design and Production (new and rebuilt)	*8*	TMDE
1	Management and Supervision		

B. Please explain (especially the top 3 choices) *Management and supervision are poor because there is little training for maintenance managers.*

Training, motivation, management is the key; with these can overcome all the others.

**High similar-response rate.*

SECTION 3: POSSIBLE SOLUTIONS TO MAINTENANCE PROBLEMS

INTRODUCTION

This section reviews the maintenance problem areas presented in Section 2 (personnel, equipment, facilities, etc.) and asks your suggestions for possible improvements. Please be as specific as possible. If you run out of space to write in, use the blank sheets at the back of the questionnaire (please indicate the question number you are responding to).

If you feel that any of the items in this section need no improvement, write in "NOT NEEDED." If you don't know how improvement for an item could be brought about, write in "DON'T KNOW." Use blank pages at back of questionnaire if you need more space to answer.

3.1 PERSONNEL

3.1.1 A. How can the availability of mechanics be increased?

Provide time (excuse from unrelated tasks). Fill TOE slots. Assign and utilize in proper MOS. Increase school quotas, output. Better grade structure. Longer rotations.*

B. How can the productivity of mechanics be improved?

Better supervision and discipline. Better training (esp. on TMDE).* Merit promotions. Less unrelated tasks. Make operator do operator maintenance instead of ORG mechanics. Train supervisors.*

3.1.2 How can mechanic's schooling be improved in terms of:

A. Quality and relevance *More hands-on, with practical tests.* More TMDE use. Better testing (fail inadequate students).*

B. Completeness (total material covered) *Lengthen (esp. 63 series). Establish specialized elec. diagnostician. More time, less O.D. More diagnosis with one-on-one training. Teach use of TM, LO, "going by the book".*

3.1.3 A. What additional incentives can be provided to maintenance personnel for outstanding work and how should they be applied?

Driver and mechanic badges, special insignia. Certificates for merit. Cmd. recognition, praise, letters, awards. More rank and/or pro. pay for merit, skill. Exempt from details/ give free time if no backlog. Treat as technician, not grease monkey/2nd class citizen. Unit competition, mechanic of month, etc. Make sure Cdr., supervisor can recognize competence.*

* *High similar-response rate.*

B. What types of additional incentives can be provided to maintenance personnel to avoid mistakes/negligence?

Use UCMJ/discipline/fire undesirable/hold liable. Extended duty hours to rectify. Group criticism/work as a team. Remove bonus, pro. pay for negligence.

3.1.4 How can maintenance personnel be encouraged to perform in a more conscientious manner, especially in:

A. Performing PM *Assure supervisor present, sets example.* Better supervision, enforcement of TMs.* Allow time. Assign oprs., mechanics to vehicles as team. Cmd. emphasis/recognition. More training and OJT.*

B. Keeping accurate records *Trained supervision, checks. Eliminate unnecessary. Cmd. emphasis and inspections. Use TAMMs clerks, not mechanics. Posters to show examples. Training on records in schools.*

C. Performing troubleshooting in a consistent manner (IAW TMs) *Supervision.* Train by the book--require TM at all times. Refresher training (with induced faults).* Cmd. emphasis on by-the-book. Show TMs make job easier. Hang TMs up in shop bays on string chains.*

3.1.5 How can On the Job Training be improved?

Trained, qualified supervision and NCO involvement. Assure assigned one-to-one to Sr. mechanic/NCO. Systematize, formalize, written plans and progress reports (not lip service). Allow uninterrupted time. Do at DIV or POST level with qualified instructors.*

3.1.6 What other possible improvements relating to personnel can you suggest that would benefit vehicle maintenance?

Allow grade or pay scale raise, not promote to another job. Authorize all units a Q.C. specialist to insure work is complete. Keep mechanic in same type unit (e.g., ARM, INF, ARTY). Don't Peter Principle mechanic to motor sgt. Mechanic should not become motor sgt. without maintenance management course.

**High similar-response rate.*

3.2 EQUIPMENT (TOOLS AND TMDE)

3.2.1 How can the quality,* quantity, and availability of maintenance tools be improved?

Improve accountability. Faster replacement. Assign tool boxes (with allocation/allowance). Buy better quality (nonbreakable). Pre-mark all tools.

3.2.2 A. How can the quality,* quantity, and availability of TMDE be improved?

Simplify; more compact, easier to use (possibly Red-Green-Amber). Modernize, consult user, use human engineering. Get lighter, less bulky LVCT. Make more rugged, less need for calibration and recall.

B. What new types of TMDE are needed?

Simpler (modular GO-NO GO). Get test sets with adapters and standardize. Get STE/ICE type. Consolidated test stand. Tach/dwell/point compression. Gen/alt/reg/starter tester. New GS level missiles and FCS tester. Emissions tester. Pistol type timing light. Simple hookup battery testers, charger.

3.2.3 A. How can maintenance personnel be encouraged to use TMDE and consistently follow approved step-by-step troubleshooting procedures?

65% ☐ Better school training in diagnosis 65% ☐ Refresher courses in TMDE
50% ☐ Other: *Periodically refresh on equipment with induced faults. Trained supervision. Emph. TMDE in OJT. Simplify. Demonstrate it works.*

B. By what practical ways can the number of different types of TMDE be reduced?

Built-in test panels (e.g., voltage reading at test pt. A in range "X"). Standardize multimeter (possibly get pocket size VOM). Standardize component parts. Get STE/ICE.

3.2.4 What other possible improvements relating to maintenance tools and TMDE could benefit vehicle repair?

Send special tools with vehicles. More power tools. Establish Diag. center. Elim. features not used at ORG, e.g, the load band on LVCT. Establish MOS for vehicle troubleshooting. Issue TMDE in Master Mechanic tool box. Improve suggestions program--many never seen at high HQ.

*"Quality" here refers to: 1) the relevance of the item to its intended job; 2) the reliability of the item; and 3) the usability of the item.

3.3 MAINTENANCE FACILITIES

3.3.1 How can repair facilities be improved?

Provide heat, water, latrines (esp. heat). Grease racks. Modernize, get mech., supervisor input to design. More overhead cranes, hoists. Provide light, ventilation, power outlets, admin. and storage space.

3.3.2 What other improvements relating to facilities (including mobile facilities) could benefit vehicle repair?

Authorize standard truck/repair van (e.g., M109) for ORG maint. Authorize mobile contact team trucks--tool and PLL vans, design for field work. Quick erect maint. tent; portable storage buildings; mobile analyzer. New technology for waste disposal in field conditions.

3.4 VEHICLES

3.4.1 How could vehicle use patterns (frequency and duration of use, number of starts/stops, etc.) be changed to decrease maintenance?

Coordinate/dispatch control/rotate vechiles on mileage basis. Use commercial vehicles for admin. tasks, errands. Stop extended engine runs in motor stables--use vehicles under load.

3.4.2 A. How could the maintenance required by vehicles a unit receives from storage be reduced?

Better QA/QC. Enforce in-storage inspection and maintenance. Better deprocessing, technical inspection (TI) before use. Review whole storage maintenance procedure.

B. How could the vehicles a unit receives from production, overhaul or rebuild be improved?

OK now. Better QA/QC at depot. More assembly repairs at GS. Proper deprocessing services by issuing agency.

3.4.3 What other improvements relating to basic reliability and maintainability characteristics of vehicles should be considered?

Built-in test equipment. Standardize. Simplify design. Get air cooled diesels (such as German DEUTZ). Get quality seals in T/M, transfer, diff'l. Put new equipment in Army unit 1 year to test--proving ground and testing areas inadequate. Reduce maintenance requirements and PM requirements (have more "maintenance free" features such as lube free steering linkage).

3.5 VEHICLE USERS

3.5.1 How can training for drivers and crews be improved?

Actually conduct it/enforce reg's. Train supervisors. Conduct hands-on training, 2-4 wk, probably at Post level.* Conduct refresher/improvement training/testing (include terrain, tactical conditions). Mobile training team to teach, issue licenses; establish by Army Cmd.*

3.5.2 A. How can drivers be made more responsible for their vehicle(s)?

Assign 1 driver per vehicle. Est. TOE for drivers; Bonus pay ($15-25/mo, depending on vehicle -remove if poor perform.) Require operators to assist mechanics. No leave, passes while vehicle nonoperational.*

B. How can drivers be encouraged to perform pre-op and post-op checks?

Supervision, stringent dispatch, don't release until proven PMCS. Spot check. Assign operator and mechanic as a team. Cdr. incentive awards, emphasis. Assign driver to specific vehicle.*

3.5.3 How can improper operation of the vehicles by operators be prevented or reduced?

Better training. Remedial/refresher training. UCMJ/financial liability/discipline ($ or extra duty).* More workable system for discipline. Trained supervision.*

3.5.4 How can communication between operators and mechanics (in reporting potential maintenance items, etc.) be improved?

65% ☐ Better training in entering faults on 2404

85% ☐ Better supervisor's enforcement of filling out 2404 by operator

30% Other: *Require operator to assist mechanic. Involve supervisors. Hold refresher classes periodically in maintenance subject. Weekly driver-mechanic sessions.*

3.5.5 What other changes relating to vehicle drivers and crews would reduce vehicle maintenance?

Less emphasis on written test, more on practical.

Adhere to driver-vehicle assignment ("his vehicle")

Training by qualified professionals.

Schedule time for operator PM before, after dispatch

Enforce section leader responsibility.

Establish slot for 20-year veteran driver.

Cmd. emphasis; instill old cavalry sense of "horse comes first."

* *High similar-response rate.*

3.6 SUPPLIES (REPAIR PARTS, POL)

3.6.1 A. How can the quality of repair parts (new or rebuilt) be improved?

OK now. Better QA (esp. at depot). Better QA for DX'd parts. Submit EIR and ROID forms. More assembly repair at DS and GS for closer control. If faulty, backtrack to find inspector.

B. How can availability of repair parts (new or rebuilt) be improved?

Increase initial procurement for expected life. Better PLL procedures and follow-up. Increase PLL, ASL. Allow more local purchase. Increase DX parts.

3.6.2 How can the quality of POL available for vehicles be improved?

Fuel: *Better unit storage, protection against weather. Maintain storage tanks, drain and clean periodically. Mandatory filtering, use of water separator.*

Oil and Lubricants: *Better unit storage; protect against weather. Use fiber grease for wheel bearings. Use 1-qt. cans. Increase oil analysis program--all engines.*

3.6.3 What other improvements relating to repair parts and POL can you suggest?

Consolidate parts at centralized locations. Use form like catalog sales store--many parts on same form. Training for PLL clerks. Multigrade oil (10-40, etc.). Store POL closer to vehicle park so mechanics can access.

3.7 MAINTENANCE INFORMATION (DOCUMENTATION AND RECORDS)

3.7.1 A. How can the quality of maintenance documentation (i.e., understandability, accuracy, relevancy) be improved for

TMs: *Simplify/illustrate. Consolidate TM and LO.*

LOs: *Simplify/illustrate. Standardize intervals. Comb. with TM.*

Other documentation (specify): *One format for all TMs. Copy style of civilian manuals (Chilton's, etc.).*

B. How can feedback of maintenance experience from units be improved?

From ORG: *Team visits - visit the field, sample. Use surveys, questionnaires. Put forms in TM/TB.*

From DS/GS: *Team visits to the field. FMT sampling. Establish weekly/monthly meetings.*

3.7.2 How can the availability of maintenance documentation be improved?

Establish responsibility for documentation in units. Send updates to units automatically acc. to TOE. Establish pub. stockage center at DIV or Post level, pick up with request signed by Cdr.

3.7.3 Which maintenance forms and records should be changed or eliminated?

DA 314. Revise 2404. Revise 2408 series (2408-14, 2408-9, 2408-1, 2408-5). Reinstate 2408-3 for history. Simplify, eliminate all not used as mgt. tools.

3.7.4 How could better summary reports be provided to commanders to give them a better overall picture of unit maintenance?

Use present, but stop falsification. Supervise/inspect; get clean DA 2406 forms. Cmd. interest, follow-up.

3.7.5 A. How can accuracy of maintenance data be increased?

Supervise, inspect, unannounced spot checks. Let them tell the truth/ don't require the impossible. Supervisor involvement (esp. in ESC preparation).

B. How can the incidence of intentional false entries be decreased?

Allow true reporting, w/o fear of bad OER, changes from higher HQ. Expose to view, discipline, instead of encourage. Spot checks by C.O./MET/Major Command. Change relation of REDCON to OER.

3.7.6 What other improvements related to maintenance records can you suggest?

For ORG: *Train data clerks. Eliminate unnecessary reports, esp. those that result in no action. Copy some civilian fleet mgt. practices. Enforce time stds. for component repairs.*

For DS/GS: *Reduce paperwork. Copy commercial system management. Use log book with tear-out forms, forward to central HQ.*

3.8 MAINTENANCE ORGANIZATION, POLICY AND PROCEDURES

3.8.1 How can the effectiveness of periodic maintenance be improved?

Daily/Weekly: *Supervisors enforce "by the book".* Plan/schedule/include on training schedule. Reduce PM, but do it. = Cmd. emphasis to see it's done.*

Semiannual/Annual: *Reduce, but do it. Schedule/allow time. Supervisor presence, involvement, enforce TM use.* Keep vehicle D/L until svcs completed. Enforce TMDE use. Cmd. interest, emphasis.*

Other (Specify): *Stand down unit--leave clerk in office, put all supervisors in motor pool. Simplify TMs/LOs--like svcs for like vehicles. Use crew to help with PM.*

3.8.2 A. How can "drive it until it breaks" policy/procedures be changed so that vehicles can be pulled for maintenance before they become inoperative?

Operator training (esp. in fault detection, reporting) Cmd emphasis, follow-up, inspection. Inspect before dispatch. More diag. checks like ASOAP.

B. If a policy of early repair (before vehicles become inoperative) were promoted, how could units be encouraged to follow it?

CMD. emphasis with clear-cut guidance. Compare ORs/show benefit to unit. Encourage "my vehicle" attitude.

C. Would this emphasis eventually result in better operational readiness, or would operational readiness be decreased due to large numbers of vehicles scheduled for maintenance?

YES - 92% (Initial backlog)

3.8.3 What improvements can be made in repair procedures for vehicles that break down in the field?

Well trained contact teams, qualified to diagnose. Better maintenance field tents, like inflatable rubberized MUST hospital shop. Conduct unit field maintenance tests/practice. Enforce fixing at breakdown site (will need commo and faster parts). More recovery capability. Cmd. emphasis on use of mobile contact teams. Authorize DS contact team truck/vehicle for onsite repairs. Experience shows more parts (PLL, ASL) must be brought to field.

**High similar-response rate.*

3.8.4 How should the formal organization or policy for maintenance resources (personnel and facilities) be changed to increase their effectiveness?

OK now--just need to enforce. Allow rank, advancement. Allow time for maintenance; have mechanic on duty 80%. Raise status of maintenance. Issue AR on Cmd. emphasis.

3.8.5 What procedures should be changed to increase the effectiveness of maintenance procedures (SOPs, work orders and priorities, assigning personnel, etc.)?

OK now--just need to enforce. Simplify, enforce SOP. Orient forward. Emphasize QA at all levels--at ORG prior to accepting vehicle from operator, at DS prior to acceptance from ORG, GS from DS--force each level to perform their part.*

3.8.6 What general improvements should be made to Maintenance Allocation Charts or the way they are used?

OK now--enforce/supervise. Illustrate/pictures. Review--some simple things can be done at ORG, save travel time. Check MACs vs. mech. training at schools. Do M113 Final Drive at ORG. Allow installation repair--evacuation to depot costly in OMA funds.*

3.9 MAINTENANCE MANAGEMENT

3.9.1 A. How can command interest in and emphasis on maintenance be improved?

Division level: *Unannounced inspections, staff visits. More emphasis, high priority on maintenance. Establish inspection teams Army-wide. Train cdrs.*

Company/Battalion level: *Train cdrs. Follow through, unannounced inspections. Allow time for maintenance on schedule.*

B. How can it become more evident?

More personal visits/cdr. present at maintenance periods/check on and follow-up problems. Maintenance priority. Army-wide program with publicity to show importance of Cmd. interest at all levels.*

3.9.2 How can supervision of PM periods be improved?

Cmd. emphasis on super. presence (admin. duty done after IDT duty). Train supervisors. Schedule, allow time, formalize.*

3.9.3 How can adherence to maintenance SOPs be better assured?

Cmd. emphasis and inspection, supervision. Make realistic and workable and relevant to unit, not inspection showpiece. Train cdr., supervisors in maintenance management. Periodic inspection using SOP as checklist.*

**High similar-response rate.*

3.9.4 How can DS/GS support to organizational maintenance units be improved?

Schedule more visits. More contact teams. Allow time/less unrelated tasks. Faster parts. Have DS/GS stop accepting work with ORG level defects.

3.9.5 A. Please rank the following areas 1 to 10 according to their need for improvement. (Number "1" would need most improvement, whereas number "10" would need least improvement, etc.)

3 Personnel shortages and turnover	9 Vehicle storage
1 Personnel training and motivation	5 Supplies (repair parts, POL)
6 Tools and TMDE	8 Documentation and forms
7 Facilities	4 Organization, policy, procedures
10 Vehicle production (new and rebuilt)	
2 Management and supervision	

B. Please explain your choice of number 1 - why does this area need improvement the most?

Personnel training--if poorly trained, motivated: can't perform.

C. Which of the above areas could be improved most easily? (Explain)

*Management and supervision.**

(Resources already there, needs least money.)

*High similar-response rate.

SECTION 4: DIAGNOSTIC AIDS

INTRODUCTION

This section presents a number of concepts related to vehicle diagnostic aids. You are asked to evaluate each concept as to how much it could benefit the maintenance program. Please judge only the concept rather than any specific item of proposed hardware.

After reading the description of each activity, indicate your judgment of its benefit by a mark on the 0 to 5 scale. Please explain your evaluation in the space provided for comment, and list any additional characteristics you think should have been included with the concept in order to fulfill the stated purpose.

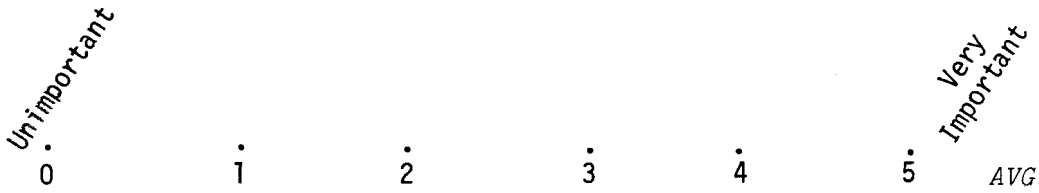
Note that these activities are not necessarily intended to replace present Army maintenance procedures, but rather to augment or improve them.

4.1 POST PRODUCTION DIAGNOSIS

Concept: Post Production Diagnosis involves use of an advanced TMDE system to check out vehicles after they come out of production (assembly line), overhaul/rebuild, or extended storage. A procedure of this type could check the vehicle at Organizational or DS/GS levels to establish its basic health or soundness before it entered operational inventory. These checks could be conducted after the vehicle had been prepared for issue. The TMDE system could monitor the integrity and performance of selected subsystems such as engine, drive train, electrical, etc. The TMDE could be connected to the vehicle while engine was running.

Purpose:
1. Reduce the number of unhealthy vehicles entering operational inventory.
2. Begin the unit's maintenance history of the vehicle.

Evaluation: Please indicate the importance of such a concept to reducing maintenance costs or increasing readiness by circling one number on the following scale of 0 to 5:



AVG: 3.1

Comment (list some characteristics this concept should include to be effective):

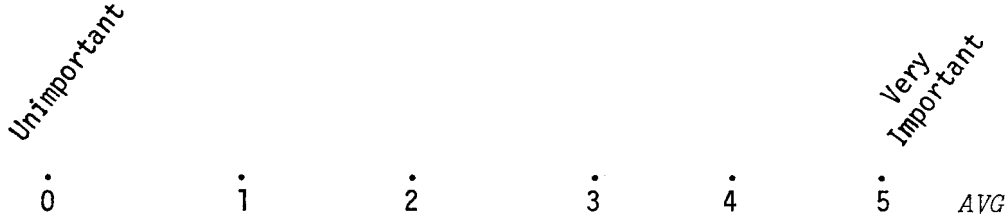
Must be simple/rapid hookup and readout. Perhaps useful only at depot (wholesale level function). Use at DS/less repairs later on. Use after storage (brake system, wheel bearings, moisture).

4.2 USE MONITORING

Concept: Use Monitoring involves on-board TMDE to record the interactions between the driver and the vehicle as well as the effect of the outside environment on the vehicle. The TMDE could sense and record selected information related to vehicle operation such as number of starts and stops, hours of operation, excess pressure, temperature or speed indications in the drive train, excess road shock, etc. The concept could extend to recording driver identification and also summary notations as to what maintenance is performed on the vehicle.

Purpose: Provide a detailed record of how the vehicle was operated in order to: 1) identify faulty or abusive operating procedures; 2) indicate when the vehicle should be scheduled for period maintenance (based on duration and intensity of operation).

Evaluation: Please indicate the importance of such a concept to reducing maintenance costs or increasing readiness by circling one number on the following scale of 0 to 5:



AVG: 3.9

Comment (list some characteristics this concept should include to be effective:

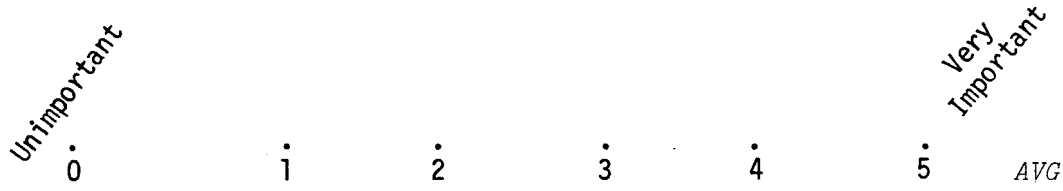
Check proper warmup, shutdown. Method of collecting the data must be meaningful. This may involve too much time, reporting, paperwork. Must be sealed/tamper-proof. Should be maintenance-free, reliable. Use for expensive equipment (tanks, APCs) only. Should include terrain type, test engine vibration, ignition, lubricants (crankcase, T/M, transfer), fuel and cooling contamination, cyl. combustion temp. and pressure, oil consumption, tire pressure, fuel and air filters, wear condition of: clutch, brakes, steering and drive train components; and should record PMCS performed. Could be effective management tool, help biggest problem Would require better supervision than is now done for tachygraph (M818).

4.3 FAILING/FAILURE DETECTION

Concept: Failing/Failure Detection involves use of an onboard TMDE system to provide GO/NO GO indications to the driver as to whether the vehicle should be driven or not. The GO/NO GO notification could be displayed by green and red lights on a dashboard indicator panel. Monitored functions could included coolant level, battery condition, pressure and temperature indications etc. The hardware system could be designed to prevent startup if unsafe conditions existed; in this case, a manual override feature would be necessary, together with an indicator to display when override had been activated.

Purpose: Display a warning when unacceptable conditions exist (fluid levels too low, filters clogged, etc.).

Evaluation: Please indicate the importance of such a concept to reducing maintenance costs or increasing readiness by circling one number on the following scale of 0 to 5:



AVG: 3.2

Comment (list some characteristics this concept should have to be effective):

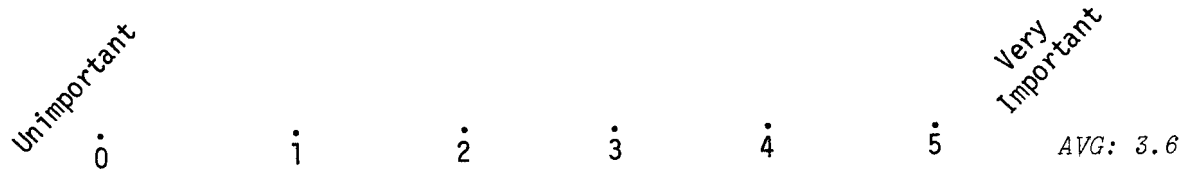
Driver will override and defeat purpose. Must report manual overrides. Need positive NO GO--operator now disconnects warning lights, ignores empty fire extinguisher and overrides safety devices. Need redundancy, periodic self-checks; needs an easy fix/replace capability, perhaps self-contained. Vehicles already have warning systems (oil, temp, buzzer for air brakes) that are ignored. Make override key operated; automatic shutdown if unsafe, e.g., press., temp., fuel press., flat tires. GO/NO GO not as reliable as gauges. Most important: leaks in engine air intake filter. Combine with Use Monitoring concept. Chief problem is in accuracy/reliability of sending units and lights; must have proven reliability to gain operator confidence.

4.4 FAULT ISOLATION

Concept: Fault Isolation involves the use of TMDE to identify and locate components that are causing vehicle malfunction. The advanced TMDE used could contain a small computer to display diagnostic testing procedures to the mechanic, and to interpret the results of such tests.

Purpose: Allow faster and more positive identification of failed components, thereby assuring that the wrong part (or too many parts) are not removed from the vehicle. The TMDE could be designed to address parts of the vehicle where faults are often harder to detect, such as the electric system.

Evaluation: Please indicate the importance of such a concept to reducing maintenance costs or increasing readiness by circling one number on the following scale of 0 to 5:



AVG: 3.6

Comment (list some characteristics this system should have to be effective):

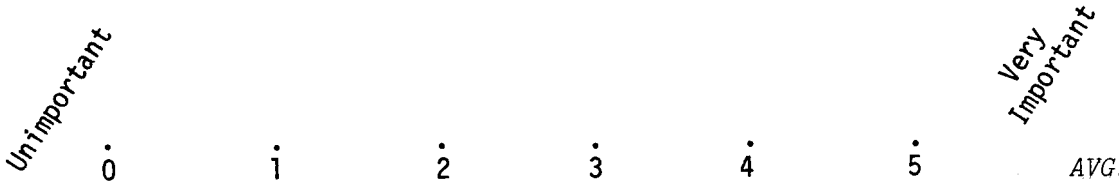
Must be simple. Make failure proof against reverse hookup. Make reliable, not requiring much calibration. Include step-by-step manual. Regular TMDE is not used; why acquire new? Make rugged, soldier proof. Simple, easy to read digital displays. Address all fuel and electrical subsystems. MUST inculcate desire to use it, else remains on shelf. Costly if need specially trained personnel to operate and maintain it Be able to use with gloves on. Self-contained power source. Test ign sys., fuel sys., press. test, battery chg. sys. Should need no calibration or be self-calibrating. Test electrical and fire control sys. (FCS). Make small, light weight. Present TMDE (VOM, LVCT) could already do this if men trained.

4.5 MECHANIC TRAINING

Concept: A Mechanic Training activity involves use of a teaching device to familiarize the mechanic with the proper diagnostic approaches to failure modes and symptoms of various vehicles and vehicle subsections. The device could be set up for initial training (in conjunction with OJT), for refresher courses, and for advanced training in diagnostic procedures.

Purpose: Increase the mechanic's productivity by augmenting training in vehicle diagnosis.

Evaluation: Please indicate the importance of such a concept to reducing maintenance costs or increasing readiness by circling one number on the following scale of 0 to 5:



AVG: 4.3

Comment (list some characteristics this system should have to be effective):

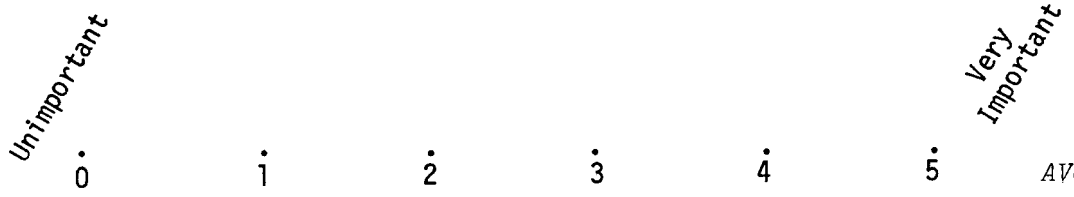
Movies and displays are not enough. Utilize all student's senses. Training devices never get used, as evidenced by many in inventory. Make mobile--geographic location of units requires you bring training to them. Insure kept updated. Have it be followed by immediate supervised application. Mechanics need this badly. Train supervisors too. Have trainers trained by factory reps. Insure training uninterrupted by menial details. Audiovisual program with realistic problems using mechanic's TMDE, repeat every 6 months. Aim system at work environment of unit, not ideal shops. Monitor to assure use (unannounced follow-ups?). Make MOBILE--use at unit or BN. Use for multi-level training: (1) at ORG to localize problem to major component, (2) at DS to isolate part within major component, (3) at GS to perform rebuild of component sections. Use mobile or ORG level simiulator training aids for hands-on instruction.

4.6 DATA RECORDING

Concept: A Data Recording activity would involve recording the incidence of various types of vehicle failures in a unit, the diagnoses that were made, the maintenance actions taken, and the User/Mechanic observations. These records would be automated and would be summary in nature.

Purpose: Assist maintenance management in keeping better track of resource allocation.

Evaluation: Please indicate the importance of such a concept to reducing maintenance costs or increasing readiness by circling one number on the following scale of 0 to 5:



AVG: 2.2

Comment (list some characteristics this system should have to be effective):

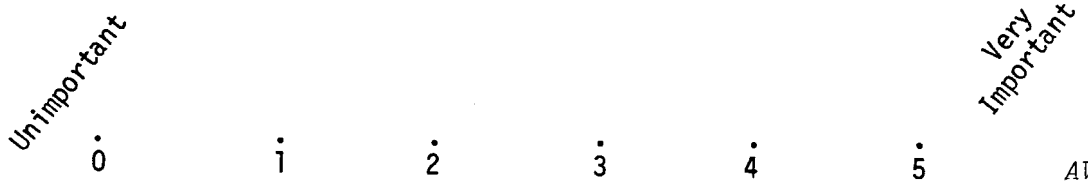
Have data now--not used. Can't get personnel to make log book entries. Form DA 2407 should be doing this. Would require monitor to assure all information is recorded. Could permit unit to isolate maintenance problems and concentrate on ways to improve job performance. System would become an end in itself. Don't need more paperwork, data collection or ADP, especially at unit level. Could only work if human element taken out--computer would work, but don't expect feedback from mechanics. Previous 2408-3 was used for this--system too complex in use. Trends can be shown by 2406. Concept OK, execution difficult. Doubtful if records accurate.

4.7 DIAGNOSTIC TEAM

Concept: This concept involves a "diagnostic team" of troubleshooting specialists organized to support Organizational and DS/GS units. The team could be under the control of the maintenance battalion headquarters, the supporting MAIT group, or similar headquarters. The team(s) would not be attached to supported units but would visit them on a regular or on-call basis. The concept could be extended to include parts control and repair verification by the team for selected systems.

Purpose: Provide the services of a team of experts equipped with modern and extensive TMDE to units in order to augment their diagnostic capability for certain areas of vehicle repair.

Evaluation: Please indicate the importance of such a concept to reducing maintenance costs or increasing readiness by circling one number on the following scale of 0 to 5:



AVG: 2.8

A. What types of specialized troubleshooting could best be handled by such a team? *Electrical. Turret/FCS. Drive train. Hydraulic and fuel.*

B. How many teams would be required to provide responsive service to the units in your area? *(1) One. (2) Three-five. (3) Two (order of preference).*

C. Would such a team add to the maintenance effort in your area or detract from it? (Explain) *Add - 60% (reduce unneeded repairs and parts, help in TRAINING); add IF use for training - 7%; detract - 33% (causes reliance on others, passing the buck, too many teams already).*

D. Could the coordination problems created by isolating the diagnostic/troubleshooting function be resolved? (Explain) *YES - 58%; NO - 42% (by time team arrives, unit would have changed components; possibly disputes between team and maintenance BN)*

Comment (list some characteristics this system should have to be effective): *Do follow up to generate, check repairs. Review parts usage. Better to have troubleshooter assigned to BN by TOE. Need M109 van with superior TMDE and highly skilled personnel. Need pers. capable of on-the-spot instruction.*

4.8 COMPARISON OF CONCEPTS

A. Please rank the following concepts 1 through 7. Mark "1" next to the concept you think is most important for improving maintenance, "7" next to the one that is least important, and so on.

6 Post Production Diagnosis	4 Fault Isolation
2 Use Monitoring	1 Mechanic Training
3 Failing/Failure Detection	7 Data Recording
5 Diagnostic Team	

B. Please comment on your choices, especially #1, #2, and #7:

#1: Mech. training most important, essential to better diagnosis; on-the-spot training of mechanics is paramount, so can give feedback on strengths and weaknesses.

#7: Data records too much time and effort, data not used now.

C. What other diagnostic concepts could benefit maintenance?

Simplified meters showing minimum required-issue to each mechanic.

Est. master diagnostician at BN, esp. for electrical.

Program for interface with oil analysis program.

Parts identification-excess time required to identify part by NSN.

Plug-in module.

D. What features of available commercial diagnostic systems would be useful for military maintenance?

Centralized drive-in diagnostic center.

Need chassis dynamometers at fixed installations.

Exhaust analyzer.

SUN type machine for non-diesel vehicles (pay for itself in 6 months).

Solid state, lightweight, versatile, parts availability.

Comments:

Factory-trained personnel.

Bench check DX'd items, e.g., Gen/Reg/Starter prior to accept at DS.

Make diagnostic training mandatory for equipment specialist, motor Sgts., maintenance officers.

Increased pay for more skill--continued updating by special courses.

SECTION 5: MAINTENANCE DATA ESTIMATES

INTRODUCTION

This section requests your estimates of resources presently expended in several areas of maintenance. Please enter the data requested for each of the four vehicles (M151, M35, M113, M48/60); if you don't know the answer to any particular question, enter "DON'T KNOW."

NOTE: PLEASE ANSWER THESE QUESTIONS IF YOUR AREA OF RESPONSIBILITY ALLOWS YOU TO PROVIDE MEANINGFUL ANSWERS. IF NOT, OMIT THIS SECTION AND GO TO PAGE 65.

SECTION 5: MAINTENANCE DATA ESTIMATES

	M151	M35	M113	M48/60
Scheduled Maintenance (SM)				
5.1.1 Is scheduled maintenance performed (check one): 1. as often as scheduled (IAW TM)? 2. less often? 3. more often?	18% 82%	16% 84%	29% 71%	29% 67% 4%
Unscheduled Maintenance (UM)				
5.1.2 How often is unscheduled maintenance (UM) typically required? a) in miles? b) in operating hours?	2175 mi 80 hr	1890 mi 65 hr	170 mi 14 hr	90 mi 14 hr
5.1.3 What subsystems are the most trouble prone (e.g., engine, transmission)?	1. Eng. 2. T/M 3. Diff/U-J	1. Eng. 2. T/M 3. Transfer Fuel	1. Eng. 2. T/M 3. Elec Track Fin. Dr.	1. Pack 2. Elec 3. Track
5.1.4 Does UM become more frequent as the vehicle ages (accumulates mileage)?	[X] Yes 85% [ ] No	[X] Yes 85% [ ] No	[X] Yes 86% [ ] No	[X] Yes 89% [ ] No
5.1.5 What % of UM actions is devoted to repairing manufacturing faults (new or rebuilt parts)?	5 %	6 %	8 %	10 %
5.1.6 What % of UM is for repairing the results of operator abuse or negligence?	50 %	50 %	50 %	50 %
5.1.7 What % of UM is for repairing failures induced by previous maintenance?	10 %	10 %	10 %	13 %

	M151	M35	M113	M48/60
5.1.8 What is the length of down-time resulting from an average* unscheduled maintenance action?	*26* hr	*35* hr	*41* hr	*40* hr
5.1.9 A. How much of this time was spent diagnosing/troubleshooting the problem (including test driving)?	*2* hr	*2 1/2* hr	*2* hr	*2 1/2* hr
B. How much more time should have been spent troubleshooting?	*1 1/2* hr	*1 3/4* hr	*1 1/2* hr	*1 1/4* hr
5.1.10 How much of this time (5.1.8) was probably spent unnecessarily repairing, replacing or adjusting good parts?	*4* hr	*5* hr	*6 3/4* hr	*7 1/2* hr
5.1.11 How much of this time was spent waiting for parts?	*6 1/2* hr	*9 1/2* hr	*8* hr	*8* hr
5.1.12 How much of this time was spent correcting earlier maintenance actions?	*1* hr	*1 1/2* hr	*1* hr	*1* hr
5.1.13 On the average, how much of this time could have been saved if the problem had been detected earlier?	*8 1/2* hr	*13* hr	*?* hr	*?* hr

*Includes: diagnosis, possible replacement of good parts, ordering and waiting for parts, repair, checkout, etc.

The following questions refer to parts* repaired/replaced for Unscheduled Maintenance (UM) actions.

	M151	M35	M113	M48/60
5.1.14 What percent of these parts are replaced due to faulty diagnosis (i.e., what % of parts are in fact still good)?	35 %	36 %	40 %	36 %
5.1.15 By what % could parts orders have been reduced if maintenance problems had been detected earlier?	44 %	43 %	40 %	48 %
5.1.16 What % of parts was needed to correct earlier maintenance actions?	11 %	13 %	13 %	13 %

*"Parts" referred to here are not ordinary nuts and bolts, but those of significant cost, installation times, size, etc.

THIS IS THE END OF THE QUESTIONNAIRE

If you have additional comments to make on any of the questions, please go back and do so.

After you are finished with the questionnaire, insert it into the envelope and turn it in to the proper command authority.

Your cooperation has been greatly appreciated.

Appendix C
EVALUATIONS OF TECHNOLOGY CONCEPTS

Section 4 of the questionnaire presented seven concepts that relate to vehicle maintenance (chiefly diagnosis). The seven concepts, which incorporate possible new technology, were drawn from a list under consideration by the Rand Land Vehicle Maintenance study team. Respondents were asked to comment on the usefulness of each concept (i.e., how much it could contribute to reducing maintenance problems) and on what features might be necessary for a system to be effective.

Comments on the seven concepts are summarized below:

1. A Post Production Diagnosis System (with advanced TMDE to check the condition of a vehicle coming to the user from production, overhaul, or storage) would be of low utility. A basic reason is that new and rebuilt vehicles are generally in good shape after leaving the depot, and so need no extensive checks. (For a more detailed description, see App. B, p. 53.)

2. A Use Monitoring System (to monitor driver misuse of a vehicle) has high potential. "Misuse" would include both improper driving and failure to check filters, oil, and water level; see App. B, p. 54. The chief concern is the paperwork and supervisory problems such a system could generate. Follow-up interviews with respondents indicated that such problems could probably be overcome. Desired features are high reliability; a tamper-proof lock; the ability to monitor proper warmup and shutdown, engine temperature, fuel and air filters; and a low administrative burden.

3. A Failing/Failure Detection System (to provide onboard GO/NO GO lights warning the driver of present/impending failure) was judged as moderately useful. See App. B, p. 55. The chief concern was whether the operator would respond to such warnings--he could choose to ignore lights and buzzers as he does presently. A second major concern was the reliability of the sensors--past and present onboard sensors have tended to fail often, and operators lose all confidence in them after even a few failures.

An automatic shutdown in case of unsafe operating conditions with key-operated override was recommended; an indicator could record use of the override feature.

4. A Fault Isolation System (with an advanced, portable microprocessor-based TMDE set for troubleshooting) was judged highly useful. See App. B, p. 56. Simplicity, especially in displays, is important, so that the soldier feels "comfortable" with the set. The set should be capable of troubleshooting electrical and electronic subsystems in addition to engine-related components. It should also be rugged and immune to easy-to-make mistakes such as reverse hookup, which can damage present-generation TMDE. Finally, the system should either be self-calibrating or need calibration very infrequently, to increase availability.

5. A Mechanic Training System (with a program using real or simulated TMDE to teach troubleshooting) was considered to be of very high utility. See p. 57 of App. B. That this concept was ranked first among the seven should be considered in light of the fact that most of the respondents were from MAIT (Instruction) teams. All respondents considered (1) the need for practical training in troubleshooting at the unit level to be almost overwhelming and (2) presently available training aids or methods to be inadequate.

Training devices should emphasize interactive, hands-on training in diagnosis, as opposed to present training approaches that involve watching films and are thus basically passive. The tone of the comments indicates that a unit-oriented maintenance training simulator (MTS) system is needed, especially to help conduct training during the OJT program. The Army presently has several MTS systems under development, but they are all oriented toward school training only; exploration of an additional MTS type of system designed for unit OJT may be indicated.

6. A Data Recording System (to automate summarized maintenance reports for management) was considered to be of very low potential utilty. See p. 58 of App. B. The chief objection was that the data going in would be inaccurate; automation of unreliable records would result in a classic garbage-in/garbage-out situation. Secondary

objections were (1) data now available are not acted upon by maintenance managers and (2) the system could entail more paperwork entry by the mechanics, a highly undesirable situation.

7. A Diagnostic Team (a mobile group of specialists with advanced TMDE performing certain types of troubleshooting for the units) was considered of low potential utility. See p. 59 of App. B. On the plus side, such a team could perform at least some troubleshooting where little or none is now being done. On the minus side, however, the units would rely on such a team too much, which could exacerbate the basic problem of mechanics' inability and unwillingness to conduct approved diagnostic procedures. Coordination and timely responsiveness might also be difficult for such a team, especially if units were on the move.

The most positive response to the concept came from respondents who thought the team could be used to *teach* as well as to diagnose. In a sense, the respondents combined some of the elements of this concept with those of the aforementioned mechanic training concept. The resultant conceptual program of a mobile team with hands-on, interactive, realistic training aids that would go units to teach troubleshooting was what the great majority of respondents felt was needed the most. The mechanics and supervisors must be motivated to accept such a program; the training cannot merely be "dumped" on them. Ideally, the program should fit into an existing system where each mechanic and supervisor knows that his pay, rank, badges, and other aspects of his career path will depend strongly upon his diagnostic capabilities, and that the training (and possibly skill testing) he receives periodically from such a program will provide essential steps along that path.

Appendix D
MAINTENANCE DATA ESTIMATES

Section 5 of the questionnaire asked respondents to estimate resources (man hours, repair parts) expended in certain areas of maintenance.[1] Actual responses, which are contained in Section 5 of Appendix B, are approximate, because (a) only a small group of respondents felt themselves qualified to answer this section; and (b) it was never intended to get "three significant figures" data from this section--gross estimates were the goal from the outset. The data, although very approximate, are of interest because of the lack of reliable official Army figures that cover this area (see R-2123-ARPA).

The opinions of the respondents can be summarized as follows:

1. Preventive maintenance is not performed as often as it should be. It seems somewhat more conscientiously applied to tracked than to wheeled vehicles.

2. Tanks have a low MTBF, with maintenance required about every 100 miles. This figure approximates that in several studies by the Army Tank Automotive Command, but is of course significantly below both factory expectations and Army requirements specifications.

3. Engines, transmissions, and (for tanks and APCs) tracks and electrical subsystems are among the most trouble-prone parts of vehicles. This may be significant to TMDE-related R&D efforts, in that the speed and cost of repairs for at least two of these systems are critically affected by the quality of the diagnoses. It would, for instance, be hard to construct a strong case for improved diagnostic capability if the bulk of repair actions involved broken suspensions, body work, and similar vehicle parts that can generally be "diagnosed" by the naked eye.

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[1]Data obtained were of interest not only to the survey effort per se, but were also used in some of the maintenance modeling efforts at Rand. See R-2123-ARPA, *A Method for Evaluating Diagnostic Aid Systems in Army Land Vehicle Maintenance*, April 1978.

4. Breakdowns increase with the age of the vehicle.[2]

5. A low percentage of new or rebuilt parts fail as a result of poor quality control.

6. A very high percentage of repair actions is due to operator abuse or misuse of the vehicles. This seems to hold for both wheeled and tracked vehicle operators.

7. A low percentage of repair actions is due to damage from previous maintenance actions.

8. An average breakdown takes the vehicle out of service one to two days. A large part of this time is spent waiting for parts. A large part of actual repair time may be spent repairing or replacing the wrong part--one that is in fact still good.

9. A significant amount of repair time could be saved if problems were detected at their inception.

10. A large percentage (up to 40 percent for certain types) of replaced parts are in fact still good. The 40 percent figure correlates well with data obtained by an unpublished Army study of "failed" parts coming into a DS center at Fort Carson.

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[2]The Soviet practice of exercising with only part of their equipment and storing the rest to keep it "fresh" for combat is apparently based on this supposition.

RAND/R-2487-ARPA